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THE LURE OF MEDICAL HISTORY[1]

THE advantages of a respectable acquaintance with the history of one's profession should be obvious to all and have been recognized by many Littré, the great lexicographer, realized that without its background a science is reduced to the category of a mere trade, and Goethe with no great poetic license maintained that the history of a science is the science itself If "each age steps on the shoulders of the ages that have gone before" (Foster), then certainly those who hope to be in the forefront of medicine must be acquainted with the body of the preceding age on whose shoulders they are to step As a matter of practical importance, too, knowledge of how knowledge accrues and of the mistakes of the past is of prime importance in preventing similar mistakes in our present work and no one is on more unsafe ground or slips with less regret on the part of the onlookers than the coxcomb, who, disregarding the past as a dead and buried conglomeration of futile and incorrect superstitions, stakes his all on his own limited vision. As Osler says, "By the historical method alone can many problems in medicine be approached profitably For example the student who dates his knowledge of tuberculosis from Koch may have a very correct, but a very incomplete appreciation of the subject." As a matter of fact, how many go even as far back as Koch?

If this is so widely recognized, why is the average ignorance of the history of our art so appalling? Chiefly because of the college and state board examinations, which before all else must be passed, so that with rapid accumulation of the facts of medical science, the curriculum becomes more and more overcrowded, the "exam" correspondingly more difficult and your vicious circle is established.

Fortunately, there are signs of a rift in the clouds, permitting the undergraduate student to regain from the curriculum time for thought and the cultivation of some of what might be called the "belles lettres" of his chosen profession Prominent among these is the history of medicine, which, if impossible for most of us to cultivate as a scientific discipline on account of more pressing work, can at least fill the position of that most useful and important activity—a hobby. Many an American physician has drawn boundless pleasure from this particular hobby and a few even

[1] From the laboratories of the Philadelphia General Hospital. An address to the Piersol Anatomical Society of the University of Pennsylvania, February 18, 1927.

have made it produce valuable contributions to the subject. Who can estimate what pleasure and benefit Osler, for instance, got from medical history, and not the least of his contributions to the art in which he became world famous was in this domain.

How can we best begin to acquire an interest in this topic, so fascinating if properly approached, so repelling as it is unfortunately often thrust at us? Certainly not by sitting down with ponderous dusty tomes, which dogmatically expound the general subject, determined to master them at the rate of so many pages a day or week Here, above all, must we avoid what the French have so aptly termed "l'ennui de tout dire" Neither, except the teacher has the gift of tongues, can we get the spirit from systematic lectures on medical history Such a prescribed course was given when I was an undergraduate by a lecturer on the subject who after about twenty lectures had not yet covered the Egyptian period! Small wonder that but few were found conscientious enough still to attend Lectures on special topics, on the other hand, can be made most interesting as well as instructive Dr Charles Singer, one of the most eminent of English-speaking medical historians, gives such a course at the University College Hospital, London, covering different fields each year. When I was there three years ago, he was lecturing on the acute infectious diseases The lecture that I heard, devoted to the history of syphilis, was attended by over one hundred students and physicians and was illustrated with numerous lantern slides and exhibits of interesting old books and prints on the subject The elective course offered here by Dr. Packard last fall was along similar lines, but unfortunately his illness forced him to abandon it when he had only covered the subject of anatomy If given next year, as I hope it will be, I should certainly recommend its selection as an elective by the senior students. Also it has no examinations!

Now how can one best begin one's own acquaintance with a subject, from which, as in any other activity, one gets out about as much as one put into it? While each individual will work this out best according to his own temperament, most will find their interest most actively stimulated by selecting some topic, perhaps already suggested by an incident in their medical work and really learning a lot about that one subject or perhaps even contributing to the general knowledge of the topic. This of course requires that the topic selected be not too large I have followed such a plan more than once to my own satisfaction. Having had to work with heart block as a second-year student, I chose the history of the subject when assigned a task for my undergraduate medical society (now alas defunct) and am confident that this was a potent factor in keeping me interested in this condition ever since. Your teachers are frequently dropping chance or purposeful remarks that will serve admirably as a catalyzer for any one on the alert to begin some reading of this kind. If still lacking a subject, an appendix to Garrison's "History of Medicine" suggests a number of such topics, sufficiently restricted to be mastered without exorbitant demands of time.

For instance, with the inroads now being made on legitimate medicine by osteopathy, chiropraxy and the various isms, any one of us should be interested in learning about the quackery and superstitions of previous ages—yes, and having learned about them, be better able to cope with what later might become a very practical matter directly affecting the fatness of our own pocketbooks.

He among you who has already picked out his own specialty—not always a wise thing to do at this stage of your career—is bound to have more satisfaction out of his life's work, as well as being a better hand at it, if he is well acquainted with its past. This research in itself will give him some of the pleasures of an investigator—for few of the specialties have had their history written up as such Most of us at one time or another have wanted to be an obstetrician What, for instance, is the history of this most ancient of specialties and how recently did it graduate from the midwife stage?

We are all more or less hero-worshippers at bottom—a quality to be proud of rather than ashamed of—and our profession has had more than its share of heroes. Why not become more intimately acquainted with some of these giants? What can be more dramatic reading than the story of Walter Reed, yellow fever and the Panama Canal; Ronald Ross and the malarial mosquitoes or Bruce and the tsetse fly? Pasteur was recognized by French popular vote as a greater national hero than Napoleon and is now commemorated by a special set of French postage stamps in current issue, and yet the average medico knows much less of the life of this altruistic, constructive genius of a kindred profession, whose work influences practically every step he takes in his daily rounds, than of the egotistical, destructive general who crippled his country in acquiring personal fame How many of us carry our acquaintance with Pasteur further than the pasteurization of milk or the treatment of rabies? Lister's epoch-making work was done during the youth of many still living and yet to how few of us is he anything more than the prefix to a mouth wash? Liebig, one of the discoverers of chloroform and a pioneer in many branches of physiological chemistry, exists to most of us as an "ad" for meat extract.

You, over there, who a few years ago were debating whether you would be a physician or a painter, why not find out how many men in the past have been both and what effect the combination had on them or, more broadly, what effect has art in general had on medicine? Such physician writers as S. Weir Mitchell, Oliver Wendell Holmes or poets such as Garth, Armstrong and Goldsmith should awaken our curiosity to know how many more have drunk of the Pierian spring as well as successfully followed some phase of medical art or science.[2]

If preventive medicine is to dominate the medicine of the next generation, surely he who is acquainted with its successes and failures in the past will be better equipped to adapt himself to and profit by the situation in the future And so on through dozens of topics, too numerous even to hint at, that will suggest themselves as readily to you as I can Break the ice, take the initial step and the rest will follow of its own impetus

As Emerson has said, "Take hold anywhere," and Garrison[3] has suggested a number of such amusing lines along which medical students might break into medical history:

The gold headed cane, St Anthony's fire, the red and white stripes on the barber's pole, the duels of physicians, the blood suckers who attended duelists in the eighteenth century in order to suck their wounds, the wound drinks of the middle ages, the purgative inks of the Arabians, the anodyne necklaces, quassia and antimony cups of the past as compared with the medicated milks, iodated foods and diuretic wines of the moderns, cupping and leeching, the seton and the moxa, the sympathetic powder for healing wounds at a distance, the use of the bare foot as a thermometer in the middle ages, the introduction of Dover's powder by a buccaneer, the statues erected to the memory of great physicians and the streets named after them, the quacks of the eighteenth century, the medical graduation ceremony, the use of botanical gardens to teach materia medica, hex-doctoring in Pennsylvania, the medical superstitions and folk ways of different races, any one of these subjects, taken at random as a starting point and closely studied, will throw you into the full current of medical history.

[2] Dr. Garrison furnishes the following additional names: (poets) Akenside, Beddoes, Blackmore, Bridges, Campion, Crabbe, Haller, Head, Kussmaul, Littré, Lodge, McCrae, Record, Ronald Ross, Saint Beuve, Schiller, Sherrington, Thayer, Volkman, Werlhof, (artists) John Bell, Bright, Seymour, Hayden, Hodgkin, Leidy, Leonardo, Lister, Pasteur, (musicians) A. de Bary, Borodin, Sir Robert Christian, J. W. Farlow, A. G. Gerster, Hesmeter, Harmann, Jacobson, Kahlbaum, Duke Karl Theodor, J. Loeb, Naunyn, Max Schultze.

[3] *J. Am. Med. Assn.*, 1916, LXVI, 319–324.

Soon the desire will come to piece together the fragments thus acquired, or to the methodical mind a preliminary survey of the whole field will perhaps be a first requisite Then such readable and reasonably brief outlines as Osler's "Evolution of Modern Medicine," Seelig's "Lectures," Dana's "Peaks," Park's "Epitome" or Libbey, Withington, Baas or Dunglison—all one-volume works—can be read with profit, even though it may not be possible to read any one from cover to cover Garrison's history is in a class by itself, comprehensive, accurate, concise, including all medical history in one volume, and yet, *mirabile dictu*, easy and pleasant reading. It is a model of what such things should be and is by all odds the first book on the subject for a student to buy The larger more detailed histories, Neuburger, Pagel, Haeser, Hirsch, Daremberg, etc., all in foreign languages, can be considered "for reference only" by us amateurs (in both senses) of the subject On the medical history of our own country, Packard's book is authoritative and I understand that there is soon to be another edition, and in the history of medical history, the seventeenth century works of Le Clerc and Freind (the two first on the subject) are quaint and interesting.

Finally let me repeat that while I am suggesting nothing that will help pass your examinations or perhaps even attract patients when you first hang up your shingle, I can assure you that the development of a love for and an acquaintance with the history of your profession will bring you something much more profitable in the long run—a capacity to advance further in that profession and a greater personal satisfaction in your work and play, both while so doing and after the more active days are past.

A Short Reading List

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(See also Appendices in Garrison's History)

E B KRUMBHAAR

DEPARTMENT OF PATHOLOGY,
UNIVERSITY OF PENNSYLVANIA

EXIT HUEBNER'S TENTAMEN!

ALL lepidopterists having a thorough knowledge of the nomenclature of their science will welcome Opinion No 97, recently handed down by the International Commission on Zoological Nomenclature (See SCIENCE, LXV, p 301) This opinion should terminate for all time the contention concerning Hubner's "Tentamen," long ago thought to have been settled, but which recently has been revived in certain quarters

Hubner's "Tentamen" is a small quarto sheet issued by Jacob Hübner, of Augsburg The title is "Tentamen determinationis digestionis atque denominationis singularum stirpium Lepidopterorum, peritis ad inspiciendum et dijudicandum communicatum, a Jacobo Hubner." Literally translated, the title is "An attempt to fix, arrange, and name the individual races of Lepidoptera, submitted by Jacob Hübner to experts for examination and the expression of an opinion" At the end the author adds a warning, "Ne expectet quis, ordinem hunc nullam amplius correctionem esse desideraturum, verumtamen magis satisfaciet necessitati, quam prævius quivis. Familiis indicandis supersedere malui" This warning says: "Let no one expect that this arrangement makes further correction undesirable, but it will more nearly satisfy necessity than anything which has gone before. I have preferred to place [it, *i e., 'the order of Stirpes'*] above the families, which *are to be indicated*"

In order to understand what Hübner meant it is necessary to understand the system of classification which he employed It was an advance upon that originally proposed by Linnæus Linnæus in his "Systema Naturæ" established among the insects the order *Lepidoptera* to include the butterflies and moths Linnæus set up only three genera *Papilio, Sphinx*, and *Phalæna* Into these three genera he put five hundred and thirty-five species. one hundred and ninety-two species under *Papilio*, thirty-eight species under *Sphinx*, and three hundred and five species of moths under *Phalæna*. Linnæus himself recognized the incongruities arising from thus throwing together a multitude of forms into but three categories, or *genera*, as he called them. He attempted to bring about a subdivision by resorting to quadrinomials, intercalating fanciful and grotesque subdivisions, which exact systematists with more time and material at their command later have discarded, or modified, adopting some of the names he employed as generic and reducing his quadrinomials to binomials But this does not concern us at this point.

The system adopted by Hubner involved a number of subdivisions. It is as follows

Order LEPIDOPTERA

a. *Phalanges* (*Germanice* Horden; *Anglice* hordes) = SUBORDERS, in modern parlance

b He divided the *Phalanges*, or Hordes, into *Tribus* (*Germanice* Rotten, *Anglice* tribes) = SUPER-FAMILIES

c He subdivided the *Tribus* into *Stirpes* (*Germanice* Stämme; *Anglice* races, or clans) = FAMILIES, as now used.

d. He subdivided the *Stirpes* or races, into *Familiæ* (*Germanice* Familien; *Anglice* families) = SUB-FAMILIES, as now used

e. He subdivided the Familiæ into *Coitus* (*Germanice* Vereine, *Anglice* unions) = GENERA in the Linnæan sense.

f. He subdivided the *Coitus* into *Genera* (*Germanice* Artez; *Anglice* kinds, or species) = SPECIES in the Linnæan sense, and as now employed.

The "Tentamen" was issued as a preliminary inquiry, bearing upon a work contemplated by the author to be issued in the future. This work is the "Verzeichniss bekannter Schmettlinge," published by Hübner in 1816. In its production he largely followed the arrangement of the "Stirpes" suggested by him in the "Tentamen," as he tells us in his introduction, adding: "I made known [the Tentamen] to the end that it might be examined and passed upon by experts before I adopted it."

On examining the "Verzeichniss" we find that he employs the "Stirpes" names, many of which he had suggested in the "Tentamen" He adds a great many "family-names," as promised in the warning at the foot of the "Tentamen" The arrangement of the butterflies in the "Tentamen" is as follows

LEPIDOPTERA

Phalanx I Papiliones

Tribus I, nymphales

I Nerëides—Nerëis Polymnia.
II Limnades—Limnas Chrysippus.
III Lemoniades—Lemonias Maturna.
IV Dryades—Dryas Paphia.
V Hamadryades—Hamadryas Jo
VI. Najades—Najas Populi
VII Potomides—Potamis Iris
VIII Oreades—Oreas Proserpina

Tribus II, *gentiles*

I. Rustici—Rusticus Argus.
II Principes—Princeps Machaon
III. Mancipia—Mancipium Brassicæ
IV. Consules—Consul Fabius.
V Urbani—Urbanus Malvæ

Turning from the "Tentamen" to the "Verzeichniss" we find under Stirps I, *Nereides,* which he cites as equivalent to *Heliconii* Linn, that the name *Nereis* nowhere occurs! We find the names *Hymenitis, Ithomia, Oleria, Eueides, Mechanitis,* etc The specific name *polymnia* Linnæus given in the "Tentamen," in the "Verzeichniss" appears under the genus (*Coitus*) *Mechanitis,* and there it has remained for one hundred and ten years since Hübner published the "Verzeichniss," as every systematist knows.

Taking up Stirps II proposed in the "Tentamen," the *Limnades,* we find that the generic (*coitus*) name *Limnas* does not anywhere occur in the "Verzeichniss," but we find under the *Limnades* such well-known generic names as *Amauris, Hestia, Euplœa, Anosia,* etc. The species *Chrysippus* L. is found in the genus *Euplœa!*

Stirps III of the "Verzeichniss" is not mentioned in the "Tentamen," but includes such genera as *Eurybia, Echenais, Mesosemia, Charis, Euselasia,* etc. Stirps III represents what we now know as the *Erycinidæ,* or, as some would have it, the *Riodinidæ.*

Stirps IV of the "Verzeichniss," = Stirps III of the "Tentamen," contains the so-called *Lemoniades.* The genus *Lemonias* is not given under the *Lemoniades!* We, however, find the genus *Melitæa.* The butterfly which in the "Tentamen" appears as *Lemonias maturna* in the "Verzeichniss" is *Melitæa maturna* Linnæus, and under this name has been familiar to every German schoolboy from the days of Hübner to the present time.

Stirps V in the "Verzeichniss" is equivalent to Stirps IV of the "Tentamen" and bears the same name, *Dryades* Under this heading we find the genera *Phyciodes, Brenthis, Argynnis, Colænis,* etc. Under the genus (*coitus*) *Argyronome* we find *A. paphia* Linn as a species. Nowhere does the genus (*coitus*) *Dryas* appear!

Stirps VI of the "Verzeichniss" is equivalent to Stirps V of the "Tentamen," bearing the same name, *Hamadryades* No genus *Hamadryas* appears anywhere in the "Verzeichniss," but among the genera enumerated under the *Hamadryades* are *Vanessa, Pyrameis, Precis, Junonia,* etc The species indicated in the "Tentamen" as *Hamadryas Io* is found as No 22 under the genus *Inachis.*

And so the student may go on throughout the entire list, discovering the fact that the apparently generic names prefixed to the species, which are cited in the "Tentamen," do not occur at all in the "Verzeichniss," of which, as Hübner tells us, the "Tentamen" was the foundation

Now what is the explanation of this fact? In order to understand it we must endeavor to put ourselves in Hubner's place and follow the workings of his mind at the time he was engaged in his studies. At the moment he sketched the "Tentamen" for submission to his learned friends and correspondents the matter immediately before him was not the setting up of genera, but the creation of what he calls *Stirpes* He was seeking for a natural subdivision of the lepidoptera into *Stirpes,* or what we now call *families* He was giving no thought whatever to the minor subdivision into genera or *Coitus* (Vereine) as he called them. In the "Tentamen" he proposes a series of *Stirpes* or family-names. In order to visualize to his correspondents what he had in mind he took the specific names of a number of well-known species and prefixed to these specific names the name of the *Stirps* (not of the genus) into which he proposed to put the insect. Any man who simply confines his attention to the "Tentamen" and fails at the same time to take into consideration the "Verzeichniss" is certain to go astray, as has unfortunately been the case with some recent writers. It is as unfortunate

for a student of this matter to confine himself and his thought to Hübner's "Tentamen" as it would be for a man endeavoring to write a life of Christ to confine himself to the Gospel according to St. Matthew and to omit all reference to the other three gospels The gospels supplement each other The "Verzeichniss" explains the "Tentamen" and shows beyond the shadow of a doubt that he is in error who accepts the names in the "Tentamen," which look like generic names, as being such in reality The "Verzeichniss" shows clearly that Hübner did not intend them to be so used He simply cites certain species as representative of what he intended to include in his proposed *Stirpes*

Passing from this critical examination of the subject, it should be said that the International Commission on Nomenclature has done right in deciding that the "Tentamen" was, as all students who have investigated the matter understand it to have been, merely a circular letter Although it was printed on paper (typewriters, hectographs and other manifolding devices were unknown in Hubner's day) it was not *published* as "a zoological record."

In this connection I can not refrain from quoting a sentence contained in a letter received from my honored friend, Dr F. A. Bather, of the British Museum, who anent the question of the "Tentamen" says. "I think it is perfectly awful to decide that a man can not ask the opinion of his friends as to the value of certain names without being thereby committed to them eternally" All that Hübner did in the "Tentamen" was to circularize his acquaintances, and he would turn in his grave if he imagined that his private correspondence, forgotten until S H Scudder published a facsimile of the letter in 1873, was being employed to upset the system he published in the "Verzeichniss," as well as to upset a system of nomenclature based in large part on his patient labors, but improved by those who have come after him, and which has been practically in use for a century

Certain workers in the field of terminology, obsessed with the idea that by slavish obedience to the "law of priority" they can establish a final and satisfactory nomenclature, should be reminded that consistent usage, covering a century, or more, in the use of names, is also not to be disregarded "A rose under any other name would smell as sweet." But roses are roses; they are not cabbages; and, when some man reminds me that certain roses long ago and even recently have been called "cabbage-roses" and tells me that I must therefore call all roses cabbages, because in combination cabbage "has priority" over rose, I naturally am ruffled.

As a student of the lepidoptera for sixty years and with the entire literature of the subject at my fingers' tips, I object emphatically to having the terminology of my favorite science upset by efforts which, however well meant, show that these who are making them possess "more zeal than knowledge."

Opinion 97 will be accepted by all thorough students of the terminology of the lepidoptera with gratification The thanks of the lepidopterists of the world are due to the Commission for the Opinion which they have handed down. It will tend mightily to clear up a situation which has been most annoying to students of the lepidoptera, as well as the great public, including compilers of dictionaries and encyclopedias. Only recently I received a letter from a young correspondent who said to me: "What is the matter? Why are they always changing the names of the butterflies? I have arranged my collection using the generic names given in your Butterfly Book Must I now call my Argynnids *Dryases;* my Vanessas *Hamadryases?*" I answered him by saying, "No! The generic names *Argynnis* and *Vanessa* have been used prevalently by reputable scientists for a hundred and twenty-five years You have the authority of all the leading writers in the world for their use."

It is high time that trifling in matters of zoological nomenclature should come to an end. As the croupier at Monte Carlo says, when a too ardent player strives to lay down his belated stakes on the table *"Le jeu est fait Rien ne va plus!"*

W. J. Holland

GEORGE BISHOP SUDWORTH

The recent death at his home in Chevy Chase, Md., on May 10, of George Bishop Sudworth, for more than forty years the dendrologist of the United States Forest Service, removes from the scientific world a man who at the time of his death was unquestionably the most eminent living authority on forest trees in the United States, and one of the greatest in the world.

Born at Kingston, Wisconsin, in 1864, he attended the country schools of those days and studied botany, ornithology, dendrology and kindred sciences. He was graduated eventually, however, from the University of Michigan, as a physician and surgeon. After a year of teaching botany at the Michigan Agricultural College, he surrendered to his natural desire for the open, and was appointed botanist and dendrologist to the old division of forestry in the U. S. Department of Agriculture on August 31, 1886, and from that date forestry became his life work. Mr. Sudworth was the oldest member of the Forest Service in point of years of service. Just a few weeks

prior to his death his revision of his well-known "Check List of Forest Trees of the United States, their Names and Ranges," first published in 1898, was issued; a work of which he was extremely proud and which was unquestionably the crowning event of his busy life, a monument to his energy, ability and knowledge of forestry

It is interesting to note that in the twenty-seven years between the date of the original publication of this valuable work in 1898 and this latest revision, more than 570 additional trees have been listed, the total number of different sorts of trees printed in the revision being 1,177

In this new check list Mr Sudworth has performed a valuable service in bringing order out of the bewildering mass of local tree names. This was a work in which he was greatly interested not only because of its value to the student and the professional forester but also as a protection to the public against deception in the purchase of lumber

In addition to the "Check List," Mr Sudworth published "Forest Trees of the Pacific Slope," "Cypress and Juniper Trees of the Rocky Mountain Region," "Spruce and Balsam Fir Trees of the Rocky Mountain Region," and "Pine Trees of the Rocky Mountain Region" Besides the works mentioned he wrote and published many other bulletins and papers on dendrology and other lines of practical as well as scientific forestry.

Mr. Sudworth was greatly interested in boy scout organizations. The section in the Boy Scout Manual devoted to tree identification was one of his contributions to that movement.

His knowledge of trees was based on broad field experiences and explorations He knew the woods as a practical woodsman as well as scientist He explored almost every nook and corner of the United States in search of new trees and information regarding doubtful species. During his years in the Forest Service he became thoroughly acquainted with all of the National Forests, and his explorations and discoveries have been invaluable aids in the administration and protection of the National Forests While he always claimed a special fondness for the oak family, he undoubtedly discovered and named more new trees of every kind than any other modern American forester. Those who have been with Mr Sudworth in the woods were always greatly impressed with his powers of close observation and keenness in discovering apparently new varieties of forest trees or deviations from established types. His wonderful memory and his ability to locate without referring to books or notes the exact place and time where he had seen trees of approximately the same kind were always matters of profound surprise.

During his explorations in the field, especially in the western United States, he was the victim of numerous unfortunate accidents which brought from him the remark one day to the effect that it seemed to him that he was destined never to die in his bed One of his most thrilling experiences was in 1910 while exploring the high mountain regions of the Cochetopa National Forest in Colorado. He and a forest ranger were caught at timberline in an unexpected snowstorm about twenty miles from the ranger station His horse stumbled in the deep snow and fell from the trail, Mr Sudworth being caught beneath the animal Cleared of the horse, he found he had broken two ribs and his collar bone The horse was uninjured, and Mr Sudworth, assisted by the ranger, mounted and rode about ten miles to an abandoned Mexican hut, arriving there just about nightfall suffering untold agonies from his injuries. Owing to the storm, it was absolutely impossible for them to travel further and they remained in the cabin that night, their only food being potatoes, of which they found a sack in the cellar of the cabin. During their enforced stay, Mr. Sudworth with his early knowledge of surgery did what he could to make himself comfortable, cutting up a saddle blanket into strips with which he bound his body to support the broken ribs and protect his collar bone from further injury At noon the next day the storm broke and they managed to reach a small hamlet where a young medical student was living, who, assisted by Mr Sudworth, did everything that could be done with their limited resources to relieve his suffering In this condition he rode in a wagon for about twenty-five miles to the nearest railroad and took the train for Ann Arbor, Michigan, where he placed himself under the care of an experienced surgeon who found the temporary remedies used very satisfactory He had at least two other such accidents, equally serious but from which he emerged without permanent injury

Mr Sudworth was one of the most lovable, kindly, companionable men imaginable. Every man in the Forest Service was his friend, and many a forest ranger and his wife hidden away in some government station in the western mountains will mourn sincerely the news of his untimely death. To spend a month with him in the forests, as did the writer, was at once an education and a privilege; a never-to-be-forgotten experience.

He was a member of the Washington Academy of Sciences, the Biological Society of Washington, the Botanical Society of Washington, the Society of American Foresters, the American Forestry Association, and an honorary member of the Finska Forstsamfundet, a Danish forestry association.

In addition to his work in the Forest Service, Mr Sudworth was for fifteen years an active member of the Federal Horticultural Board, being one of its original members, taking a very lively interest in its work especially in relation to the importation and interstate shipment of nursery stock which might spread insect pests and diseases of trees.

He was married to Frances Gertrude Kingsbury, of Michigan, in 1897 and left no children.

His body was sent for burial to his early home at Crossopalis, Michigan.

WILL C BARNES

U S FOREST SERVICE

SCIENTIFIC EVENTS

MEMORIAL OF THE RESEARCH CLUB OF THE UNIVERSITY OF MICHIGAN

IN the deaths of Wm J Hussey, Alfred H Lloyd and Francis W Kelsey the Research Club mourns the loss of three most distinguished members, who were not only able research workers but were even better known for their promotion of research and of the facilities for research

Professor William Joseph Hussey achieved international distinction through his contributions to Astronomy, especially in the field of binary stars, and brought his department in the University of Michigan to the point where it was regarded as one of the foremost in his subject in the United States Products of his efforts in the direction of provision for research are found in the additions to the Observatory of the University of Michigan, the now active La Plata Observatory and the Lamont Southern Observatory in process of erection in South Africa Products of his research are found in the volumes of the Lick, the La Plata, and the Detroit Observatories, and in considerably more than one hundred papers in various astronomical journals

Dean Alfred Henry Lloyd, a philosopher who pondered the problems of ultimate being and made great progress in ordering man's conception of them, had an influence on research which can not be measured by the five books and numerous articles published by him As graduate dean he gave every encouragement to the promotion and publication of investigations in every field and made many innovations in organization and in obtaining funds that were of great assistance in themselves and set precedents that promise much for the future.

Professor Francis Willey Kelsey was elected to the Research Club within recent years, though he had long been known as an able scholar and a tireless worker both in organizing research and in gathering material for it His most conspicuous achievement during his earlier period was the establishment of the University of Michigan Studies, Humanistic Series, of which the 21st volume will appear this year. His own published books were either textbooks or translations, two of which, however, the Mau-Kelsey *Pompeii*, and Hugo Grotius *Law of War and Peace*, contained much original work. Most of his research work, however, is found in shorter papers, which appeared in the various classical journals In 1920 he organized the Near East Expedition of the University, which has already made Michigan the leading American university in its collections of papyri, manuscripts and archeological material The value of the research which his efforts have occasioned and will continue to make possible can not be over-estimated

THE NATIONAL ARBORETUM

FOLLOWING one of the provisions of the act of the last congress establishing a National Arboretum at Washington, Secretary of Agriculture Jardine has announced the membership of the advisory council, which is to plan and develop the arboretum The members are Frederic A Delano, Washington, D C, member of the board of regents of the Smithsonian Institution, *Chairman,* Dr L. H Bailey, Ithaca, New York, Henry S Graves, dean of the School of Forestry, Yale University, Harlan P Kelsey, Salem, Mass, John C Merriam, president of the Carnegie Institution of Washington, Mrs Frank B. Noyes, Washington, D C, chairman of the District of Columbia committee of the Garden Club of America, Frederick Law Olmsted, Brookline, Mass., former president of the American Society of Landscape Architects; Mrs Harold I Pratt, Glen Cove, L I., secretary of the Garden Club of America, Robert Pyle, West Grove, Pa., director of the Society of American Florists and Ornamental Horticulturists

The act authorizing the secretary of agriculture to establish the National Arboretum is as follows.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of Agriculture is authorized and directed to establish and maintain a national arboretum for purpose of research and education concerning tree and plant life For the purpose of this Act, (1) the President is authorized to transfer to the jurisdiction of the Secretary of Agriculture by Executive order any land which now belongs to the United States within or adjacent to the District of Columbia located along the Anacostia River north of Benning Bridge, and (2) the Secretary of Agriculture is authorized in his discretion to acquire, within the limits of the appropriation authorized by this Act by private purchase, condemnation proceedings, or gift, land so located or other land within or adjacent to the District of Columbia· *Provided,* That the purchase price of any part of said land shall not ex-

ceed the full value assessment of such property last made before purchase thereof plus 25 per centum of such assessed value

SEC 2 There is hereby authorized to be appropriated a sum not to exceed $300,000, to be expended under the direction of the Secretary of Agriculture for the acquisition of land as specified in Section 1 No payment shall be made by the United States for any such land until the title thereto is satisfactory to the Attorney-General and is vested in the United States

SEC 3 In order to stimulate research and discovery the national arboretum established by the Secretary of Agriculture in accordance with the provisions of this Act shall be under competent scientific direction The arboretum shall be administered by the Secretary of Agriculture separately from the agricultural, horticultural and forestry stations of the Department of Agriculture, but it shall be so correlated with them as to bring about the most effective utilization of its facilities and discoveries

SEC 4 The Secretary of Agriculture is authorized to create an advisory council in relation to the plan and development of the national arboretum to be established under this Act, to include representatives of national organizations interested in the work of the arboretum

MOSQUITO CONTROL

COLONEL S P JAMES, M D, of England, and Professor N H Swellengrebel, of Holland, interchange observers of the Malaria Commission of the Health Secretariat of the League of Nations, are visiting the United States to inspect mosquito eradication and control methods According to a statement made by Dr Hugh S Cumming, Surgeon-General of the U S Public Health Service, they will visit, primarily, the southern areas of the United States, where modern methods of mosquito control are being used with a view to eradicating the purveyors of malaria Methods which they consider practical will be introduced into European countries where malaria is present They also will endeavor to advise health authorities in this country on the procedure employed in Europe in mosquito control. They are making the inspection trip in the United States as the guests of the International Health Board, with which the Public Health Service is cooperating.

Accompanying Colonel James and Dr. Swellengrebel is Colonel F. F Russell, U S Army, retired, who Dr Cumming stated is the man chiefly responsible for anti-typhoid vaccinations in the army Colonel Russell is now affiliated with the International Health Board.

Dr Cumming also pointed out that the United States is recognized as the country foremost in developing malaria control measures, and has evolved many methods of eradication, both of malaria and of mosquitoes that convey the disease.

One of the latest methods employed by the Public Health Service in cooperation with other government agencies is the use of airplanes in spraying a potent mixture of Paris green over marshy areas that were breeding grounds for mosquitoes This method has proved eminently successful, and also has proved to be an economical method both from the standpoints of time consumed and money expended

AWARD OF THE LANGLEY MEDAL

THE fourth award of the Langley Medal of the Smithsonian Institution was made on June 11, to Colonel Charles A Lindbergh On behalf of the Board of Regents, Dr Abbot made the presentation to Colonel Lindbergh in person at the National Press Club reception in the Washington Auditorium, on June 11 Dr Abbot said

The Smithsonian Institution knows how to appreciate the pioneering work of brave men You will recall, as a single example, our honored one armed hero, Major Powell, who dared for science the first passage of the uncharted raging waters of the Grand Canyon of the Colorado, strapped in his boat We are not less stirred to admiration by your own daring in the first non stop flight from New York to Paris over the boisterous Atlantic through icy clouds that threatened death

Nor is the institution failing to appreciate, sir, the precious results in the encouragement of aviation, in the strengthening of ties of international friendship, and in the progress of science, which have already begun to flow from your achievement

The Smithsonian has in its gift a medal which commemorates the name of Samuel Pierpont Langley, the third secretary of this institution He had the audacity to believe in the practicability of the art of flying when all men were ridiculing it, and he adventured his own high reputation as a man of science to lay the groundwork of exact experiments, and to make pioneering flights of large models, which demonstrated the soundness of his faith The Langley Medal has hitherto been presented to Wilbur and Orville Wright, to Glenn H Curtiss and to Gustave Eiffel Thus it is from all points of view the medal of pioneers It is highly fitting that it should now be awarded to you, sir, the pioneer of audacious, solitary flight to distant shores

Therefore, acting on the unanimous recommendation of an eminent committee of award, the regents of the Smithsonian Institution have voted to you the Langley Medal, and have recorded their action in this paper signed by the chancellor, Mr. Chief Justice Taft, which I now present to you.

The actual medal, in gold, is being struck in Paris I hope that when it is received you may do the institution the honor to appear on some suitable occasion and receive it in person.

APPOINTMENTS AT THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE board of scientific directors of The Rockefeller Institute for Medical Research announces the following appointments and promotions

NEW APPOINTMENTS

Member	Dr Carl Ten Broeck
Associate	Dr Arthemy A Horvath
Assistants	Dr Mortimer L. Anson
	Miss Alice H Armstrong
	Dr Alan M Butler
	Mr Albert E Casey
	Mr Edwin B Damon
	Dr Claude E Forkner
	Mr Henry P Gilding
	Dr Alvin R Harnes
	Mr Oscar M Helmer
	Dr Alexander Hoffman
	Dr Perrin H Long
	Dr Alfred E Mirsky
	Dr Gordon H. Scott
	Mr Robert E Steiger
	Mr Ernest Sturm
Fellow	Mr Rene J. Dubos

PROMOTIONS

Associate Member to Member	Dr Thomas M. Rivers
Associate to Associate Member	Dr Carl A. L Binger
	Dr Leslie T. Webster
Assistant to Associate	Dr Lillian E Baker
	Dr Lawrence W Bass
	Dr Walther F Goebel
	Dr Lawrence S Kubie
	Dr Fred W Stewart
	Mr James van der Scheer
Fellow to Assistant	Mr Irving A Cowperthwaite

Dr Ten Broeck is at present professor of bacteriology and Dr Horvath assistant in medicine at the Peking Union Medical College, Peking, China.

Dr. Pierre L du Nouy will spend the next year at the Pasteur Institute, Paris

SCIENTIFIC NOTES AND NEWS

AT the commencement of Yale University, the doctorate of science was conferred on Dr John Jacob Abel, professor of pharmacology, of the Johns Hopkins University, on James Colquhoun Irvine, principal and vice-chairman of the University of St Andrews, and on Dr Alfred North Whitehead, professor of philosophy in Harvard University; the doctorate of laws on Dr Charles Value Chapin, health officer of Providence, Rhode Island, and the master's degree on George Hoyt Whipple, pathologist, dean and professor of pathology of the School of Medicine and Dentistry, University of Rochester; on William Buckhout Greeley, chief forester of the United States; on Commander Richard E Byrd, first aviator to fly over the North Pole, and on Charles L Lawrence, designer of aeronautical engines.

THE University of Wisconsin has conferred the honorary degree of doctor of science on Dr George David Birkhoff, professor of mathematics in Harvard University, on Dr. Frank Baldwin Jewett, president of the Bell Telephone Laboratories, Inc, and on Dean De Witt Lewis, surgeon-in-chief to the Johns Hopkins Hospital.

THE doctorate of laws of the University of Rochester was conferred on Dr Michael Idvorsky Pupin, who gave the commencement address, and the doctorate of science on Dr Harrison E Howe, editor of *Industrial and Engineering Chemistry*, and on Elon H Eaton, professor of biology at Hobart and William Smith Colleges.

HARVARD UNIVERSITY has conferred the degree of doctor of science on Dr George Edmund de Schweinitz, the oculist, of Philadelphia.

DR. ALICE HAMILTON, assistant professor of industrial medicine at Harvard University, received the degree of doctor of science at the commencement exercises of Smith College

DARTMOUTH COLLEGE has conferred the degree of doctor of laws on Dr Max Mason, president of the University of Chicago, and the degree of doctor of science on Professor Dayton C Miller, of the Case School of Applied Science, and on Professor Frank P Brackett, director of the observatory of Pomona College

THE University of Georgia has conferred upon Professor Andrew H Patterson, head of the department of physics at the University of North Carolina, the degree of doctor of science

AT its graduation exercises, the Massachusetts Agricultural College conferred the honorary degree of doctor of laws on Dr Edward M. Lewis, president of the University of New Hampshire.

DR WILLIAM E. WICKENDEN received the degree of doctor of engineering at the commencement exercises of the Worcester Institute of Technology.

GUSTAVE WHYTE THOMPSON, chief chemist of the National Lead Company, delivered the graduation address at the Armour Institute commencement exercises in Chicago and received the honorary degree of doctor of science.

AT the ninety-third annual commencement exercises of Franklin College, Franklin, Ind, Dr. Harry Edgar

Mock, assistant professor of surgery in the Northwestern University Medical School, was awarded the honorary degree of doctor of science

THE Oklahoma State College, Stillwater, Okla., at its thirty-second annual commencement, May 31, conferred the honorary degree of doctor of science upon Professor W A Tarr, professor of geology at the University of Missouri, and the honorary degree of doctor of agriculture upon Professor W L Burlison, professor of agronomy at the University of Illinois These degrees were the first conferred by the college

AT a meeting of the Royal Institution on May 9, Sir J J Thomson was elected honorary professor of natural philosophy, and Sir Ernest Rutherford professor of natural philosophy. The chairman announced that the president, the Duke of Northumberland, had nominated, among others, Sir Dugald Clerk and Sir Charles Parsons as vice-presidents for the ensuing year

THE first award of the Charles B Dudley medal, established by the American Society for Testing Materials, has been made to Dr D J McAdam, Jr, metallurgist at the United States Naval Engineering Experimental Station at Annapolis, Md, for a paper on "Stress Strain—Cycle Relationship and Corrosion—Fatigue of Metals"

A PORTRAIT of Dr William S Baer, chief medical officer at the Children's Hospital School, Baltimore, and associate professor of clinical orthopedic surgery at the Johns Hopkins Medical School, has been presented to the hospital school

PROFESSOR ALAN W. C. MENZIES, of Princeton University, will represent the American section of the Society of Chemical Industry at its annual meeting in Edinburgh in July, and will tender the invitation of the section to the society to hold its next annual meeting in New York.

DR. ERNEST W. BROWN, professor of mathematics at Yale University, has been appointed to represent the University of Cambridge at the centenary of the University of Toronto on October 6.

DR. H. L. WALSTER, dean of the School of Agriculture of the North Dakota Agricultural College, was elected president of the North Dakota Academy of Science for the coming year at the recent conference held at Grand Forks. Dr. Walster succeeds Professor Karl H. Fussler, head of the department of physics of the University of North Dakota. The Academy will hold its next convention at Fargo.

PROFESSOR K. D. GLINKA, director of the Soviet Experimental Station at Leningrad, has been elected president of the International Congress of Soil Science, composed of delegates from thirty countries. Leningrad will probably be chosen as the place for the next meeting

SIR DANIEL HALL retired on June 4 from the post of director-general of the intelligence department of the British Ministry of Agriculture, which he has held since 1920 He will continue to act as chief scientific adviser and chairman of the Research Council of the Ministry.

SIR RICHARD GLAZEBROOK has been appointed, by Order of Council dated May 26, to be a member of the Advisory Council to the Committee of the British Privy Council for Scientific and Industrial Research.

MISS ELIZABETH F HOPKINS, assistant botanist in the Seed Testing Laboratory of the New York State Agricultural Experiment Station at Geneva, has resigned in order to accept an offer from the Massachusetts Agricultural College to organize a seed testing laboratory at that institution.

DR THOMAS A JAGGAR, of the Hawaiian Volcanic Observatory, has arrived in Alaska, where a scientific study of volcanic eruptions and earthquakes is being carried out by the U S Weather Bureau He will superintend the installation of seismographs at Dutch Harbor and at Kodiak.

DR HERBERT GROVE DORSEY, senior electrical engineer of the U S Coast and Geodetic Survey, has been transferred to the Pacific Coast for a few months to supervise the installation and adjustment of the fathometer on the survey ships *Pioneer, Guide* and *Surveyor,* working off the coasts of Oregon, Washington and Alaska.

O. M MILLER, director of the school of survey of the National Geographic Society, headed a party which sailed for South America on June 23 to explore the source of the Maranon River, one of the chief tributaries of the Amazon.

NEIL M JUDD, curator of American archeology in the United States National Museum, has left Washington to complete his explorations at Pueblo Bonito, New Mexico, under the auspices of the National Geographic Society This season's expedition is the seventh sent by the society for the purpose of recovering and recording the story of this prehistoric Indian village.

DR. WILLIAM B WHERRY, professor of bacteriology at the University of Cincinnati and member of the Board of Health, will lead an expedition into Mexico this summer to test the efficacy of the new treatment for typhoid fever.

DR. WILMOT C. FOSTER, assistant professor of anatomy of the University of Oregon Medical School, has

been granted a year's leave of absence to work in surgical anatomy at the Mayo Clinic, Rochester, Minn.

MRS AGNES CHASE, associate botanist in the grass herbarium of the Bureau of Plant Industry, has returned from Europe where she spent several weeks studying type specimens of American grasses She visited the herbaria at Vienna, Freiburg, Munich, Paris and Geneva. Of special importance was the De Candolle Herbarium acquired by the Delessert Herbarium, Geneva, and recently made accessible to visiting botanists by the director, Dr John Briquet. The material of the De Candolle Herbarium, which is the basis of the Prodromus and the series of monographs, is segregated in the De Candolle Room, the remainder is incorporated in the general collection of the Delessert Herbarium

Nature states that Mr H C Sampson, who was recently appointed economic botanist at the Royal Botanic Gardens, Kew, left on June 11 for British Guiana at the invitation of the governor and under the auspices of the Colonial Office and Empire Marketing Board, to study and report on various agricultural matters in the colony He will also visit Trinidad and the Imperial College of Tropical Agriculture, and Barbados

FRANCIS G BENEDICT, director of the nutrition laboratory of the Carnegie Institution of Washington, in Boston, recently gave at the University of New Hampshire a lecture on "Physiological Research Institutions of Europe"

DR SERGIUS MORGULIS, professor of biochemistry in the University of Nebraska College of Medicine, delivered an address on "Enzymes in the Service of the Cereal Chemist" at the annual convention of the Association of American Cereal Chemists on June 3

THE medical library composed of 4,424 volumes, of the late Dr George S Huntington, professor of anatomy in the college of physicians and surgeons of Columbia University, said to be one of the rarest of its kind, will be purchased by the alumni, who have undertaken to raise a $35,000 fund for the purpose in memory of Dr Huntington The collection will be known as the George S Huntington Collection and will be kept intact at the medical center

DR. CHARLES FREDERIC MABERY, for thirty-five years head of the laboratory of the Standard Oil Company and since 1883 professor of chemistry at the Case School of Applied Science, Cleveland, died in Portland, Me., on June 26, at the age of seventy-seven years

CHARLES FREDERIC RAND, former chairman of the executive board of the Engineering Foundation, died on June 21, at the age of seventy years.

JOHN M GOODELL, former editor of the *Engineering Record* and an associate editor of *Engineering News*, died on June 22, aged sixty years

THE fifteenth International Geological Congress will meet in South Africa in 1929

THE Swiss Society of Natural Sciences will hold its 108th annual meeting from September 1 to 4 at Basel The president, Dr Fritz Sarasin, will give the opening address on September 1, which will be followed by a lecture by Professor A Brachet (Brussels) on the causes and factors of morphogenesis; other lectures will be given by Professor L Courvoisier (Berlin) on recent work and views in astronomy, by Professor L Duparc (Geneva) on the Urals from the point of view of geophysics, geology and mining, and by Professor H E Sigerist (Leipzig) on Paracelsus in relation to modern thought. The general work of the meeting will be divided among fourteen sections

THE Cyrus F Brackett series of lectures at Princeton University next year will include a lecture by L. H Kinnard, president of the Bell Telephone Company of Pennsylvania, on October 15 on "Development of Long Distance Telephony", by the president of the National Broadcasting Company of New York, M H Aylesworth, on "Radio—The University of the Air", by Dr Frank B. Jewett, president of the Bell laboratories in New York, on "Cooperative Research," and by James T Wallis, assistant vice-president of the Pennsylvania Railroad, who is to speak about "The Development in Motive Power on the Pennsylvania System"

DR E H ANDERSON, director of the New York Public Library, writes "Add one more to your record of copies of Durant's 'The Algae and Coral Lines of the Bay and Harbor of New York' The New York Public Library has Durant's own copy of this book"

THE firm of Johnson & Johnson, manufacturers of surgical supplies, New Brunswick, N. J., has established at the Mellon Institute of the University of Pittsburgh a fellowship that will study the exact requirements of surgeons and other medical specialists in the way of sundries, with the joint aim of developing new supplies that are needed and of standardizing the products now in use. An investigation will also be made of the processes of renovating used supplies, and several other Industrial Fellowships of the Institute will cooperate in devising satisfactory procedures. Dr. Frederic H. Slayton, M.D. (Rush) will be in direct charge of this research. All its investi-

gations will be conducted primarily for the benefit of the public. It is the plan to report the results in appropriate periodicals as the various phases of the studies are concluded

THE Royal Aeronautical Society has recently received the following letter from Mr Harry F Guggenheim, president of the Daniel Guggenheim Fund for the Promotion of Aeronautics, Inc · "It affords me great pleasure to advise you that the Daniel Guggenheim Fund for the Promotion of Aeronautics, Inc, has approved a grant of $5,000 to the Royal Aeronautical Society to enable it more easily to continue its splendid contributions to the aeronautical science of the world. It is the hope of the fund that this grant may stimulate the growth and strength of the Society to such a point that within a short while financial assistance from without will be unnecessary"

TEMPORARY reservation of a tract of public land in Nevada containing Lovelock Cave has been authorized by an executive order issued by the U S Department of the Interior The area on which the cave is located contains approximately 40 acres and is in Churchill County. Its withdrawal is for the purpose of affording opportunity of scientific study of interesting prehistoric material found in the cave According to the secretary of the Smithsonian Institution articles taken from Lovelock Cave are in a remarkable state of preservation and are particularly valuable on this account. With its temporary retention in public ownership as a result of the executive order, the site will be the subject of further archeological research

THE National Forest Reservation Commission met recently, under the chairmanship of Secretary Davis, of the war department, and approved the purchase of 96,000 acres additional to the White Mountains National Forest in New England, the Allegheny in Northwestern Pennsylvania and the Pisgah in North Carolina. The commission also gave a hearing to a delegation from New England which urged the purchase of 23,000 acres within the boundaries of the White Mountain National Forest in New Hampshire, containing one of the few virgin timber stands in Northeastern United States No decision was reached

AN Imperial Agricultural Research Conference, at which delegates from all parts of the Empire will be present, will be held in London beginning on October 4. The Ministry of Agriculture and Fisheries decided some time ago to call such a conference in 1927, and the proposal was endorsed by the last Imperial Conference, which appointed a special sub-committee to inquire into research. The ministry is responsible for arranging the conference, and the Empire Marketing Board is providing the necessary funds. An organizing committee has been appointed under Lord Bledisloe's chairmanship and has already held its first meeting

MILK ISLAND, lying off the coast of Gloucester, Mass., has been accepted by the state as a wild life sanctuary, according to an announcement of the state division of fisheries and game of the Department of Conservation The island is the gift of Mrs Roger Babson to the Federation of the Bird Clubs of New England, upon condition that it shall be known as the Knight Wild Life Reservation, in memory of Mrs. Babson's mother and father The federation, in turn, has deeded the property to the state in trust for this purpose, and the governor and council have accepted it by formal vote. It will be administered by the Fisheries and Game Division, of which William C Adams is director

UNIVERSITY AND EDUCATIONAL NOTES

AT the commencement exercises of Harvard University it was announced that during the year 1926–27 the university had received gifts of $6,003,372, in addition to subscriptions to the ten-million-dollar campaign and to the alumni endowment fund and the income received under the will of Gordon McKay Most of these gifts have during the year been chronicled in SCIENCE Those of special interest to scientific men include anonymous, for research and instruction in abnormal and dynamic psychology, $25,113, from the estate of Richard Dana Bell, for biological chemistry in the medical school, $100,000, from the General Education Board for the department of ophthalmology, $188,400, from the International Education Board endowment, for a southern astronomical observatory, $180,000, from the estate of Arthur S Luke, for medical and surgical science, $237,081, from the Rockefeller Foundation, for the school of public health, $137,250, from the Laura Spelman Rockefeller Memorial, for industrial psychology and for a survey of crime, $37,000, for the Charles Sprague Sargent Memorial Fund, $142,720, from Dr. Frederick C. Shattuck, to establish the Richard P. Strong Fund in Tropical Medicine, $100,000; from Harold S Vanderbilt, for a medical school dormitory and salary for an instructor of physical training in the medical school, $470,100.

GIFTS to Wellesley College amounting to $814,000 were announced at the recent commencement exercises, bringing the Centennial Fund to $7,220,000. The gifts include $100,000 by George W. Farwell, of Boston, to establish the Ruby Frances Howe Farwell chair of botany, and $40,000 from the class of 1882, for the Susan Hallowell chair of botany A gift of

$30,000 by Mrs Robert Gould Shaw will be divided: $10,000 to the Hallowell chair of botany, $20,000 to the Hallowell Arboretum

BOWDOIN COLLEGE has received a gift of $175,000 from Augustus F Moulton, of Portland, for the construction of a Bowdoin Union, to be the social center of the college

THE legislature of the state of Kansas before adjournment appropriated $300,000 for the erection of new buildings for the school of medicine of the University of Kansas at Kansas City $100,000 is for a new nurses' home and $200,000 for an additional ward unit.

THE University of Pittsburgh announces the appointment of Dr Robert T Hance as professor and acting head of the department of zoology Dr. Hance has been associated for the past several years with the Rockefeller Institute for Medical Research.

AT the Carnegie Institute of Technology the following appointments have been made John H Neelley, associate professor of mathematics, Howard V Russell, assistant professor of physics and Walter H J. Taylor, assistant professor of chemical engineering

THE following promotions are announced in the department of psychology at the University of Pennsylvania: to professorships of psychology Drs Samuel W Fernberger and Karl G Miller, and to assistant professorships of psychology. Drs Robert A Brotemarkle, Henry E Starr and H Sherman Oberly

DR R L SHRINER, associate in biochemistry at the New York State Agricultural Experiment Station at Geneva, has accepted a position in the chemistry department at the University of Illinois.

DR. TOMLINSON FORT, head of the department of mathematics at Hunter College, New York City, has resigned in order to accept a similar position at Lehigh University

DR ALEXANDER G RUTHVEN has been elected chairman of the department of zoology at the University of Michigan, and Dr Robert R McKibbin, assistant professor of soils at the University of Maryland, has been appointed lecturer in the chemistry department of Macdonald College, McGill University, Ste Anne de Bellevue, Quebec, Canada.

DISCUSSION AND CORRESPONDENCE

CONCERNING "SPECIES-GRINDING"

IN SCIENCE for December 10, 1926, Dr James G Needham gives an interesting and well-deserved encomium of the natural history work of Dr. Curtis Gates Lloyd. But in praising his friend, Dr Needham quotes from one of the least laudable of his personal prejudices.

In a general criticism of workers in taxonomy as engaged in "species-grinding," "practiced for the purpose of seeing one's name in print," "a sort of cheap notoriety which places a premium on slip-shod and hasty description," he takes a needless slap at a group as a whole signally unselfish and conscientious For systematic zoology and botany give most of our clues to the origin of species, and therefore to "organic evolution," and on accuracy in taxonomy rests all our actual knowledge of geographical distribution Slip-shod amateur work in any field is a nuisance in science, and there is no field it may not sometimes invade The greater the public interest in any branch of science, the more likely it is to attract the charlatan and those unquiet spirits who find the methods of science too slow and laborious

In the interest of accuracy, taxonomists are obliged to resort to what Dr Lloyd calls contemptuously "The time-wasting devices of priority hunters because he deemed them a hindrance to science" In like manner care for tools or instruments of precision in any science is likewise "time-wasting" It takes effort as keen for an anatomist to keep his knives sharp as for a geneticist to keep track of his observations The eminent "intuitionists" do not do this, and in the long run their inspired guesses count for nothing

More than eighty years ago Agassiz justified the work he put on his "Nomenclator-Zoologicus," as an effort to save systematic zoology from the utter confusion into which it was then falling It was plain to him, as to all conscientious workers that the language of systematic science could not be altered at will without being made incomprehensible and useless, and that the law of priority was the sole basis on which order in the naming of any group could be established. If for any reason a writer rejects an earlier or established name for one he likes better, it opens the door to anybody's play of choice Take any name you like or make a new one, and all continuity and certainty is lost. We know more or less well a million kinds of animals and almost as many plants, and we are not yet near the end of the list. To declaim against law and order in nomenclature is a sin against accuracy. That there are so many kinds of life in one small world is not the fault of naturalists Facts are facts, and our duty is in Agassiz's oft-quoted words, to "strive to interpret what really exists"

All easy problems in biology are already solved, and any of the others may bring up new points of view. Practically also, one line of genuine work in any field is just as difficult as in any other and just as important. To sneer at any other lines of

effort as of low order or as "hodman's labor," is a mark of ignorance, not of critical judgment.

A word as to the custom of quoting the author of a name adopted for a species Its chief motive is in convenience and accuracy, almost or quite never for the purpose of "giving some one a sort of cheap notoriety" It is, of course, not always necessary, and when needless it is seldom done.

DAVID STARR JORDAN

STANFORD UNIVERSITY,
MAY 5, 1927

BIOLOGY VERSUS MYTHOLOGY IN A CRIMINAL COURT

A LARCENY trial unique in the annals of criminology, resulting in conviction by a jury of five on March 15, 1927, grew out of a series of thefts of preserved frogs from the Southern Biological Supply Co, Inc, of New Orleans, La, by two former collectors of the company The interesting feature of the trial was virtually a clash between modern mythology on the one hand and the sciences of ecology and taxonomy on the other A single charge was filed covering only one theft, that of 462 preserved frogs consisting of five species, four of local and one of northern distribution The defendants, pleading not guilty, set forth the plea, through their attorney, that *it is a well-known fact that evaporation draws frogs and fish up into the clouds and the rain showers them again onto the land* It was therefore easily explained how the race of Rana pipiens indigenous to Indiana and Wisconsin was collected in St. Bernard Parish in southeast Louisiana by the collectors, who sold them to a competitor and to a local university

The employees of the company described and identified the five species in the barrel from which the frogs were stolen, these including a large percentage of Rana pipiens which had been imported from the two northern states during the shortage resulting from the unprecedented droughts of 1924 and 1925 Every detail in the chain of circumstantial evidence was presented by the state, even the purchasers acting as state's witnesses. Percy Viosca, Jr., and Henry B. Chase, Jr., of the Biological Company, were qualified as experts in taxonomy and ecology of the Anura, and it was necessary for living and preserved frogs to take the stand as exhibits in order to prove the story of the defendants untrue. A surprise of the trial was the presentation by the defendants of living specimens of Rana pipiens which they claimed they caught in St. Bernard Parish the night before the trial in a typical Rana sphenocephala habitat, several hundred miles from the nearest approach of the range of pipiens. The defense attorney then attempted to prove that the defendants had secured their knowledge of frogs through experience, whereas the state's experts had secured theirs from book study, but it was proven otherwise. The verdict was in a sense a victory for science in that the results of scientific study seemed to make a better impression upon a jury of New Orleans citizens than the fables and argumentation of the defense attorney.

PERCY VIOSCA, JR.

NATURAL HISTORY BUILDING,
NEW ORLEANS, LA

DATUM AND DATA

I HAVE more than once publicly protested against that abomination "data is" We say "phenomenon is" and "phenomena are," and I do not recall in Latin any singular verb used in English with a plural noun, excepting poor "data is."

I presume one reason is that "datum" is a rare word The city "Datum" is the fixed level from which all heights and depths are measured, and "data" are the basic facts upon which we found a definite conclusion I am glad to join with Dr. Morse in his protest against a singular verb and a plural noun

The Oxford, the Century and the Funk and Wagnalls dictionaries all give "data, pl of datum" Webster's does not list "data" but under "datum" says "pl data"

W. W KEEN

IN view of certain remarks which have appeared in SCIENCE recently concerning the use of the word "data," I feel minded to essay the rôle of devil's advocate for the apparently incorrect use. We speak and hence write English by ear and not by rules of grammar Rules to the contrary notwithstanding, if "this data" sounds better than "these data" it will be used. There must be a more fundamental reason why "data" should be regarded as a singular rather than a plural I believe there are two reasons. First, in this country we regard collective nouns either singular or plural in form as syntactical singulars. Such does not seem to be the case in England. For example. in this country "the committee is," while in England "the committee are," yet the phrase "committee of one" shows that we regard a committee composed of a single person as the exception, not the rule Second, in ordinary use, "data" is not the mere plural of "datum" The two words possess quite different connotations. "Datum" appears to be almost exclusively used for a primary level in surveying while "data" connotes information or facts. Hence "data" as the plural of "datum" is a syntactical plural while "data" in the sense of facts is a collective which is preferably treated as a singular.

CHARLES H. BLAKE

AIRGRAPHY OR AEROGRAPHY?

In the *Bulletin* of the American Meteorological Society (April 1927, p 69) the suggestion is made that the word *aerography* (study of the air) henceforth should be written *airgraphy* On this side of the Atlantic we have done away with the word aëroplane (which certain of the Boeotians pronounced a-ery-o-plane) and use the simpler, equally expressive term airplane.

A new reason for adopting the change is found in the increasing use of the word *areographic* by astronomers in connection with planetary atmospheres

Thus, Professor W H Wright, of the Lick Observatory, discussing the ice cap on Mars speaks of "the exact areographic position of every cloud or atmospheric peculiarity"

If we are to continue the use of aerographic and areographic, we offer the types a fine opportunity to do their worst in transposition; to say nothing of professorial orthography!

And, while we are about it, can we not abandon *meteo*graph and *meteo*therm for airgraph and airtherm?

ALEXANDER MCADIE

BLUE HILL OBSERVATORY

"ASTRONOMIC"

WHO introduced the word "astronomic" into astronomic literature and why did he do it? "Special Publication No 110 of the U S Coast and Geodetic Survey" is entitled "Astronomic Determinations" Plans have been made for "An Ideal Astronomic Hall" in the American Museum of Natural History, though there is some comfort in the fact that it is "to be devoted to astronomical and kindred subjects . " We even find the terms "astronomic latitude" and "astronomic time" in a recently published astronomic text-book I see no object in lining up the comfortable old word "astronomical" with geocentric, pneumatic, egophonic and gastronomic If we don't look out, some one will take all the joy out of our new word "astrophysical"

RAYMOND S DUGAN

PRINCETON UNIVERSITY OBSERVATORY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

DIRECTIONS FOR DETERMINING THE COLLOIDAL MATERIAL OF SOILS BY THE HYDROMETER METHOD

IN the issue of October 8, 1926, of this journal there appeared a brief article proposing the hydrometer method as a very rapid means of determining the colloidal content of soils. Since the publication of this paper a great number of letters have been received asking for more detailed information as to technique, kind of hydrometer used, etc In view of this large number of inquiries, it has seemed advisable to publish in advance of the main report the directions for executing a colloidal determination and other essential information concerning the method

The use of the hydrometer method for determining the colloidal content of soils in only fifteen minutes is based upon the fact that there is a remarkably close relationship between the colloidal content of soils as determined by the heat of wetting method and the percentage of material, based on the sample taken, that stays in suspension in a liter of water, at the end of fifteen minutes There is a fundamental basis for this relationship, for it holds true for all types of soils and various amounts of samples taken The only soils that do not give a very close relationship are the peats and mucks and this is because it is almost impossible to disperse those organic materials

The success of the hydrometer method for determining colloids is based upon a complete dispersion of the soil This can be accomplished remarkably well and most rapidly by means of a stirring motor, such as is used in mixing malted milk In using this machine, however, care must be taken to use a special cup made purposely with baffles in it in order to prevent the circular motion to which the soil-water mixture is subjected without these baffles The machine will disperse a soil in ten minutes which an ordinary shaker will require more than twenty-four hours to accomplish

The soils can be dispersed also by hand from about ten to fifteen minutes, but such dispersion can not be uniform and not always complete and consequently is not recommended If it is absolutely necessary to disperse by hand, then the following procedure may be followed Place fifty grams of soil, 100 grams in case of sandy soils, based upon the dried basis in a mortar, add enough distilled water to make a paste and pestle vigorously Add more water to make a thin suspension, stir, let it stand half a minute and pour supernatant liquid in the cylinder Pestle the paste again vigorously and again add water to make suspension and at the end of half a minute pour supernatant liquid in the cylinder Continue this operation until all the clays are dispersed or the liquid is almost clear. To the mixture add 5 cc of 1N KOH. For making hydrometer readings follow directions given below.

If the stirring motor is used, the procedure is as

follows: Place fifty grams of dry soil in the cup, in the case of sandy soils 100 grams, add 5 cc of 1N KOH, fill cup with distilled water one and one half inches from the top and stir it by the motor for nine minutes. The mixture is then washed into a cylinder having a total capacity of about 1,130 cc. The hydrometer is placed in the cylinder and the latter is filled clear to the top with the hydrometer still in it in order to facilitate the reading of the hydrometer from the top of the liquid column. The hydrometer is then taken out, and the mixture is stirred vigorously for about a minute, using one palm as a stopper. The cylinder is placed on the table and the time is quickly noted, preferably by a stop watch. The hydrometer is put in the mixture and at the end of fifteen minutes the reading is noted. Just about half a minute before the fifteen-minute period is up, however, the hydrometer is pushed down gently in order to avoid any lagging. The reading, which is grams per liter, is divided by the weight of sample taken, and the result is percentage of colloids in that soil. The temperature of the mixture is also noted and the necessary correction made. All readings must be reduced to 67° F., which is the temperature at which the hydrometer was calibrated. A change of 1° F makes a difference of about 0.35 per cent of colloids. For temperatures above 67° F. the corresponding amount is added to the percentage indicated by the hydrometer, and for temperatures below 67 the amount is subtracted.

The hydrometer gives an average measurement of the densities for the entire column of liquid, down to where the solid soil column is formed. To make allowance for the water required to saturate the soil, 1,050 cc of water is added to every fifty grams of soil. A special cylinder is made which, when filled entirely with soil and hydrometer in it, will contain 1,050 of water, and thus the necessity of having to measure the water every time is eliminated. An ordinary 1,000 cc cylinder may also be used by making a mark of the proper volume.

The method may appear empirical, but it really gives quite absolute results. The results it yields are also absolutely comparable for different soils. For instance, the rate of settling of soil particles is governed largely by their size. This being the case, then the amount of material staying in suspension at any given time has about the same average size of particles for the different soils. The hydrometer, when floating, is governed entirely by physical laws without any outside factors entering or any personal element entering into it. Its readings, therefore, are quite accurate.

Since the hydrometer method gives absolutely comparable results for the different soils, and since the results show a very close relationship with the results of the heat of wetting method, it probably means then that the heat of wetting method for determining the colloidal content of soils has been a correct method. Evidently, both methods tend to measure the same thing.

From all our present knowledge, it appears that the hydrometer method can be employed to determine the colloidal content of soils, quite accurately. The method is also very rapid, the colloidal content of more than three soils can be determined in less than one hour, using only one hydrometer.

The hydrometer can also be used to measure the rate of settling of soil particles from which a distributed curve should be worked out.

Referring once more to the dispersing machine there are two things that must be strictly guarded against, the first is that the cup must have the baffles or wires in it, and the second is that the paddle or button on the stirring rod tends to wear out in sandy soils. When it becomes flat it must be replaced, because in the flat condition it loses its stirring efficiency. With these two precautions to watch out for, it can be said that this machine is most wonderful for dispersing soils for any purpose.

The detailed report of this work will appear in *Soil Science* shortly.

GEORGE J. BOUYOUCOS

MICHIGAN AGRICULTURAL EXPERIMENT STATION, EAST LANSING

SPECIAL ARTICLES

THE LIFE HISTORY OF TAPEWORMS OF THE GENUS MESOCESTOIDES

THE generic name *Dithyridium* Rudolphi, 1819, has been used by zoologists to designate agamic cestodes having an elongate body and containing an invaginated scolex which bears four suckers but lacks both hooks and a rostellum. These larval parasites have been reported from a variety of mammalian and non-mammalian hosts, in most cases in relation with the body cavity and its membranes and viscera. In one instance they have been reported from the voluntary muscles and the heart. Morphologically these larvæ appear to occupy a position intermediate between those of pseudophyllid and cyclophyllid cestodes, their general body shape resembling that of the former, whereas the scolex is suggestive of a cyclophyllid tapeworm.

Although there has been some speculation as to the relationship of these larvæ to known strobilate tapeworms, no conclusive experimental work designed to elucidate the ultimate development of Dithyridium

larvae has been published up to the present time.[1] Neumann (1896), Ransom (1907) and some other investigators have been struck by the morphological similarity of the scolex of Dithyridium and that of the genus Mesocestoides parasitic in the intestine of various mammals and birds. Neumann appears to have been the first investigator who suggested a connection between Dithyridium and Mesocestoides. Unfortunately, that investigator postulated what appears to be an unsound biological hypothesis to account for this relationship and his experimental work designed to test his hypothesis is decidedly inconclusive, a fact which he himself recognized. Neumann was inclined to regard Dithyridium as an erratic, immature cestode (Mesocestoides) which succeeded in reaching the body cavity apparently as a result of perforating the stomach or intestinal wall or in some other manner and which was destined to perish in this location without completing its further development. He also postulated a direct life cycle for Mesocestoides and expressed the opinion that the ingestion of hexacanth embryos of this tapeworm by a suitable host probably results in the development of a mature strobilate tapeworm in the intestine.

Recent investigations by the present writer have shown Neumann's interpretation of Dithyridium to be erroneous. Not only have these parasites a typical larval organization, consisting of a simple unsegmented ribbon-shaped body and an invaginated head provided with four suckers, but in common with other infective larval tapeworms they are capable of reaching maturity in the small intestine of a suitable definitive host When ingested by a susceptible host Dithyridium develops into a strobilate tapeworm belonging to the genus Mesocestoides. Dithyridium thus bears the same morphological and biological relationships to Mesocestoides as Sparganum bears to Diphyllobothrium and as Cysticercus bears to Taenia.

Briefly stated, the writer succeeded in rearing Mesocestoides in dogs and cats as a result of feeding them Dithyridium obtained from the peritoneal cavity and lungs of a mongoose. As early as forty-six days after ingestion of Dithyridium, gravid segments of Mesocestoides were found in the feces of dogs which prior to experimental infection were ascertained to be free from cestodes Fifty-one days after experimental ingestion of five live specimens of Dithyridium, five mature specimens of Mesocestoides were recovered from a cat at necropsy Before ingesting the larvae the cat was free from tapeworms so far as fecal examinations showed anything As Mesocestoides has never been found in native dogs and cats in the Eastern United States, it seems safe to assume that that no such worms were present.

On the basis of these experiments, which it is hoped will be supplemented by the results of additional feeding tests which are now in progress, it may be safely concluded that the definitive host becomes infected with Mesocestoides as a result of devouring a carcass or a portion of a carcass of an animal harboring Dithyridium and that the latter is not a tapeworm which has accidentally strayed from its course but is a true larva in a normal location in an intermediate host.

It still remains to be determined whether the hexacanth embryos contained in the egg capsule of each gravid proglottid of Mesocestoides are capable of infecting the intermediate host directly, as is known to be the case in cyclophyllid cestodes whose life histories have been determined, or whether the embryos undergo their earlier larval development in an invertebrate, intermediate host before they can metamorphose into infective larvae in a vertebrate, intermediate host The answer to this question must await the results of experiments which are now in progress

While this investigation was in progress an abstract[2] of a paper in Russian by Skrjabin came to the writer's attention. Among other references to Professor Skrjabin's recent work in helminthology was the statement that he had found that mice are the intermediate hosts of *Mesocestoides lineatus*.

Benjamin Schwartz

Zoological Division, Bureau of Animal Industry, U. S Department of Agriculture

ACCLIMATIZATION OF BUFO TADPOLES TO ETHYL AND METHYL ALCOHOLS[1]

That animals may become immune to toxic substances that ordinarily will destroy them is too well known to call for comment. Since the work of such pioneers as Sewall and Erlich a mass of information has been collected on this subject. Yet in one phase, at least, the experimental data are not consistent. Studies of the resistance that organisms exhibit towards alcohol after they have been immersed in a weak solution of it for some time have failed to produce uniform results. Daniel ('09) has made rather an extensive study of the effects of ethyl alcohol upon Stentor and Spirostomum, subjecting them for various periods of time to a weak solution of the alcohol, and then killing them along with controls in a stronger solution In general he holds that the ani-

[1] This manuscript was submitted for publication on April 8 and while it was in the hands of the editor Professor Henry published a paper (Rec de méd vét., v. ciii, no 8, April 30, 1927) reporting experimental results essentially similar to those covered in this paper.

[2] Berl. tierarztl. Wchnschr., v. 42 (52), Dec. 24, 1926.

[1] Contribution from the Department of Zoology, University of Michigan.

TABLE I

Showing acclimatization to alcohols. The animals designated "treated" were either kept in a weak solution of methyl or of ethyl alcohol for a number of days, or were exposed to an 8 per cent solution of ethyl alcohol for 5 minutes each day for several days. The results shown in the table were obtained by exposing for 20 minutes equal numbers of treated and control tadpoles to 11 1/9 per cent methyl or 8 per cent. ethyl, depending on the alcohol to which the treated animals had been exposed, after which all were transferred to water and the number that recovered noted

Alcohol used for acclimatization	Concentration of alcohol used to test for acclimatization	Number of tadpoles used in the experiment		Number of tadpoles that recovered		Percentage of tadpoles that recovered	
		Control	Treated	Control	Treated	Control	Treated
Methyl	11 1/9 per cent methyl	107	107	11	43	10 3	40 2
Ethyl	8 per cent ethyl	207	207	44	102	21 3	49.3

mals did become acclimated The treated protozoa generally lived considerably longer than the controls Yet of the two strains of *Stentor* employed, one, while given exactly the same treatment as the other, showed little or no indication of acclimatization and led the author to remark (p. 611), "the fact that in these experiments some strains show little or no capacity for becoming acclimatized to alcohol although tried for long periods of time and with refined methods makes is questionable whether acclimatization takes place so readily and to so high a degree as is commonly supposed" Bills,[2] using Paramoecium and adopting a method similar to that of Daniel,[3] maintains that he not only obtained no indication of acclimatization, but that the treated animals were even less resistant to alcohol than those that were untreated

An attempt to find out whether Bufo tadpoles will become acclimated to ethyl and methyl alcohols led to the experiments presented below The tadpoles were put in solutions of one per cent and three fourths per cent ethyl alcohol, and one per cent., one half per cent. and one fourth per cent methyl alcohol for periods varying from three days to about three weeks In addition a number were treated for five minutes each day for several days with an eight per cent. solution of ethyl alcohol, which brought about complete narcotization, and were then returned to water and allowed to recover. Finally all were tested for acclimatization by placing them along with controls into 11 1/9 per cent. methyl or 8 per cent. ethyl alcohol for 20 minutes, after which they were transferred to water and the number that recovered ascertained The results, greatly abbreviated, are given in the accompanying table.

Examination of the table will show that 107 animals were subjected to weak methyl alcohol and later placed for 20 minutes in a 11 1/9 per cent solution of the same alcohol along with an equal number of controls, and that 43 of the treated animals recovered when they were transferred to water, while only 11 of the controls recovered The table also shows that out of 207 tadpoles treated with ethyl alcohol, 102 recovered after having been subjected to an 8 per cent solution of the alcohol for 20 minutes, and that only 44 out of a like number of controls recovered These results seem to point unmistakably to an acclimatization

Owing to the small number of animals used one can scarcely draw any conclusions as to the relative effects of the various solutions, and for this reason a detailed account of the experiments has not been given The exact time required for acclimatization and the effect of one alcohol upon the ability of the tadpole to withstand another are also problems deserving of solution, but which the data at hand are too meager to solve. A more comprehensive set of experiments is contemplated, designed to throw light on these questions.

HARRY THOMAS FOLGER
UNIVERSITY OF MICHIGAN

[2] Bills, C. E., "Some Effects of the Lower Alcohols on Paramoecium," *Biol. Bull.*, vol. 47, pp. 253–264. 1924.

[3] Daniel, J. F., "Adaptation and Immunity of the Lower Organisms to Ethyl Alcohol." *Jour. Exp. Zool.*, vol. 6, pp. 571–611. 1909.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE SECOND NASHVILLE MEETING OF THE ASSOCIATION AND ASSOCIATED SOCIETIES

PREPARATIONS for the second Nashville meeting of the American Association for the Advancement of Science and associated societies, which will occur from December 26 to 31, are very well begun. Adequate lodging accommodations will be available, partly in hotels and partly in the Ward-Belmont and Peabody dormitories The general headquarters will be the Andrew Jackson Hotel, in which will be the registration and news offices and the science exhibition. Headquarters for the societies that are to meet with the association will be announced later. Scientific sessions will be held mainly in the buildings of Van-

derbilt University and of the Peabody College for Teachers.

Announcement may now be made of the local committees that are in charge of preliminary arrangements, which are constituted as follows

General Chairman of Nashville Committees

W S Leathers, M D, professor of preventive medicine and public health, Vanderbilt Medical School

Committee on Arrangements

John W Barton, *chairman*, vice-president of Ward Belmont College

H. A Webb, *secretary*, professor of chemistry, George Peabody College

L C Glenn, professor of geology, Vanderbilt University

G Canby Robinson, dean and professor of medicine, Vanderbilt Medical School

J T McGill, professor emeritus of organic chemistry, Vanderbilt University.

A E Parkins, professor of geography, George Peabody College

W. N Porter, convention secretary of the Nashville Chamber of Commerce

J M Breckenridge, professor of chemistry, Vanderbilt University

G. R. Mayfield, associate professor of German, Vanderbilt University.

A. F. Ganier, assistant engineer, L & N Railroad

A J Didcoct, business manager, George Peabody College

H H Shoulders, president of the Nashville Academy of Medicine

E L. Bishop, State Health Commissioner of Tennessee

A W Wright, assistant professor of pathology, Vanderbilt Medical School

H C Weber, superintendent of the Nashville Public Schools

Committee on Finance

John W Barton, *Chairman*
Henry E Colton
Charles M McCabe

Committee on Meeting Places

A E Parkins, *Chairman*
F J. Lewis
R E Baber
W H Hollinshead
W. D Strayhorn

Committee on Hotels and Housing

W N Porter, *Chairman*
Lee J Loventhal
S C Garrison

Committee on Exhibition

J. M Breckenridge, *Chairman*
F B. Dressler
E W. Goodpasture

Committee on Local Transportation

A F Ganier, *Chairman*
J P W Brown
W F Pond

Committee on Publicity and Non-technical Lectures

G R Mayfield, *Chairman*
H A Webb
T J Norner
T H Alexander
J S Stahlman, Jr

Committee on Entertainment

A W Wright, *Chairman*
C P Connell
Mrs A B Benedict
W W Carpenter
Alf Williams

Each section of the association has, as usual, a local representative to look after the needs of the organizations that are related to the section A list of the names of the local representatives is given below

Representatives for Sections

Section A (Mathematics), C. M. Sarratt

Section B (Physics), C R. Fountain.

Section C (Chemistry), L J Bircher

Section D (Astronomy), James McClure

Section E (Geology and Geography), L C Glenn

Section F (Zoological Sciences), E E Reinke.

Section G (Botanical Sciences), J M Shaver

Section H (Anthropology), W. D Weatherford

Section I (Psychology), Joseph Peterson

Section K (Social and Economic Sciences), C. B. Duncan

Section L (Historical and Philological Sciences), H. C. Sanborn.

Section M (Engineering), W. H Schuerman

Section N (Medical Sciences), P D. Lamson.

Section O (Agriculture), K. C. Davis

Section Q (Education), S. J. Phelps.

For organizations not related to any particular section, C. P Connell.

Correspondence about local arrangements for the societies that are to take part in the Nashville meeting should be addressed to Dr. W. S Leathers, general chairman of local committees, American Association for the Advancement of Science, Vanderbilt University, Nashville, Tenn.

Burton E. Livingston,
Permanent Secretary

SCIENCE

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PRESENTATION OF THE KOBER MEDAL TO DR. WILLIAM H. WELCH[1]

REMARKS OF GEORGE M KOBER

Mr President and Colleagues

DR WARTHIN doubtless with great self-denial, which I deeply appreciate, has assigned to me the most pleasing function in my life, to pay tribute on behalf of this association to William Henry Welch, the father of scientific medicine in America, and the most respected and beloved member of the medical profession No words of mine can add luster to the laurel wreaths which have been bestowed upon him both at home and abroad, and worn with his innate modesty and dignity for so many years

It may, however, be a source of inspiration to the younger generation of this association to recount briefly the achievements of a man to whom this country and the world is so greatly indebted[2]

Dr. Welch was graduated in 1875 at a time when the outlook for the future of scientific medicine seemed brighter than ever before Pathology under the leadership of Virchow and his pupils had made tremendous strides, and with the birth of bacteriology there was also a ray of hope for the prevention of human suffering and distress.

Welch, with his high ideals and noble aspirations, and conscious of the defects in our medical educational system, was determined to prepare himself well for the practice of one of the most difficult and responsible of all professions In order to lay the foundations in modern pathology, he journeyed to Strassburg in the spring of 1876, where he pursued studies in normal histology under Waldeyer, physiological chemistry with Hoppe-Seyler and post-mortem demonstrations by von Recklinghausen Later he went to Leipzig for further work in histology and physiology with Ludwig and Kronecker

Among foreign students were Pawlow and Drechsel and Flechsig Welch, in addition to his regular courses, was set by Ludwig to study the ganglia and nerves of the auricular septum of the frog's heart with the gold chloride impregnation method, in the course of which he actually brought into view the

[1] By the Association of American Physicians for Research in Scientific Medicine.

[2] See Simon Flexner's exhaustive Introduction to the Contributions and Addresses of Professor Welch published on his seventieth anniversary, 1920

ganglionic cells with T-shaped fibers, which Ranvier described in detail somewhat later.

By a singular coincidence I was studying that year at Camp McDermit, Nevada, a collection of 250 specimens illustrating normal and pathological histology prepared in Ludwig's laboratory, and purchased for me by my friend, Dr John S Billings, of the U. S Army

At the end of his first year of European studies, Welch was fully prepared to take up the solution of unsolved problems in pathology, and his ambition was to do so under the direction of Virchow

It was perhaps fortunate for our Jubilarian that he accepted the suggestion of Ludwig and others, to go to Breslau and study pathology under Cohnheim, a brilliant pupil of Virchow, then in the prime of life At all events he spent a most profitable semester dividing his time between the autopsy demonstrations conducted by Weigert and the experimental investigations of Cohnheim The particular theme assigned to Welch was "The Origin of Acute General Oedema of the Lungs" This thesis prepared in German proved to be a high testimonial to his thorough painstaking scientific qualifications at the age of twenty-eight years, three years after his graduation It was published in Virchow's Archives and the *Berliner Klin. Wochenschrift* in 1878

While at Cohnheim's laboratory he met Koch, Cohn, the botanist, Ehrlich and other great foreign students, among them Salomonsen, who afterwards became professor of pathology at Copenhagen.

On his way from Breslau to Vienna, Welch stopped at Prague to see Klebs and his excellent collection of preparations showing micrococci in the ulcerative lesions of acute endo-carditis, he was also equally impressed with his work on diphtheria and experimental syphilis

In Vienna he entered Stricker's laboratory for experimental pathology, and likewise enjoyed unlimited opportunities with Chiari in gross pathology

After the Christmas holidays he spent a few days at Würzburg with Rindfleisch and his assistant, Ziegler, and again went to Strassburg to visit von Recklinghausen, who chose as a theme for special study the inflammation of the cornea of the frog and also engaged him in the discussion of a number of other profitable topics After a visit to Ranvier, the great histologist, and the main hospitals of Paris, he went to London and, according to Flexner, heard Lister lecture at King's College Hospital and shared in the prevailing excitement which arose from Lister's daring surgical exploit of opening the knee joint Of course Mr Lister was not aware of the fact that a young "soldier and cowboy doctor" at Camp McDermit, Nevada, had been bold enough two years before to treat successfully a perforating gunshot wound of the knee joint, which had become septic, with tincture of iodine and carbolic acid. Thanks to the advice of Dr. Billings, the case was published in the *Journal of American Medical Sciences* for October, 1876, and also in the third surgical volume of the War of the Rebellion Although the use of iodine has become almost a universal procedure, I never saw any reference to this case in the surgical texts

This incident has not shortened my life, and I trust you will pardon this immodest digression, when I tell you it had much to do with the foundation of a lectureship and the association medal, so that the work of members of the various associations with which I was connected might be properly evaluated.

But to resume the life work of the man in whose honor we have met, it is perfectly natural that soon after his return to New York he was offered a teaching position at his alma mater, the College of Physicians and Surgeons, which he declined, but recommended Dr Thomas M Prudden He preferred to accept a professorship at the Bellevue Medical College, largely because of a promise that suitable laboratory facilities would be supplied Here he lectured on general pathology and demonstrated the pathological lesions preparatory to Austin Flint's brilliant lectures, he also revised and largely rewrote in 1881 the pathological anatomical sections of Flint's "Treatise on the Principles and Practice of Medicine." It is easy to see that his thorough preparation had also attracted the attention of the planners of the Johns Hopkins University Hospital The prospect of a full-time salaried position, prompted his acceptance in 1884, and with the establishment of the medical school in 1892 he became professor of pathology

His splendid pioneer work in Cohnheim's laboratory was followed by thirty-three important contributions, many of these like his experimental study of glomerulonephritis, the pathology of fever, thrombosis and embolism, hemorrhagic infarctions, malignant diseases of the stomach were presented or discussed before this body. Among a total of 335 contributions, seventy appear in the transactions of this association

During the six years after his first European tour, as Flexner has pointed out, the center of interest had begun to shift from Virchow's cellular pathology to microbiology, and the conception of the microbial origin of infectious diseases, based upon the rapid and startling discoveries by Pasteur and Koch and their pupils, appealed very strongly to Welch, especially as he had witnessed Koch's demonstration of his Anthrax work in Cohnheim's laboratory in 1877.

Hence his goal in 1884 was Berlin and Koch. Upon the latter's advice he went first to Bollinger's lab-

oratory at Munich, where he prepared himself under Frobenius in Koch's technique. Here he also met men like Buchner, Esherich, Lehmann, Neumann, Celli and others. He also became interested in animal pathology at the Veterinary School and the diseases transmissible from animals to man, and was likewise an enthusiastic worker in von Pettenkofer's Institute for experimental hygiene In January, 1885, at the suggestion of Koch he took a course in bacteriology under Flügge at Gottingen, after which he was amply prepared to receive the final touch of preparation in Koch's laboratory, by the great master Dr Welch's association with these beacon lights in scientific medicine has always been gratefully remembered and the ties of friendship have never been broken, except by death

That he has made good use of his opportunities in the field of bacteriology is evidenced by the fact that he himself discovered in 1892 the *staphylococcus epidermides albus* and its relation to wound infection and in the same year also the *bacillus aerogenes capsulatus;* in 1900 he grouped the diseases caused by this organism In 1891–1892 he with Flexner demonstrated the pathological changes produced by experimental injection of the toxins of diphtheria, simultaneously with Von Behring How well he cultivated this new field is attested by his thirty-one published contributions to the subject.

Thoroughly equipped as he was in the fundamental sciences of preventive medicine and the first, so far as I know, to enunciate, that the "highest aim of scientific medicine is the eradication of preventable disease," we find him spreading the gospel of public and personal hygiene in 1889, followed by sixteen other important contributions. In addition he devoted twenty-four years (*i e*, 1898–1922) of his precious life to the duties and responsibilities of the office as president of the Maryland State Board of Health His humane efforts have been duly rewarded by the Rockefeller Foundation in the establishment of the School of Hygiene and Public Health in 1916, of which he was the director until a few months ago

As a keen and competent observer and critic, Dr Welch had recognized and deplored the glaring defects in medical education in our own country and with a truly patriotic spirit started his campaign for higher medical education in 1886.

Others had called attention to this subject and urged higher standards, and the employment of full-time salaried laboratory men and research workers, without much avail. His twenty-five contributions on medical education, based upon conclusive facts gradually made a profound impression.

The voice of a man, who had become a master in all of the medical sciences, who had turned out a long list of brilliant pupils as successful investigators, who, had stimulated into existence the Rockefeller Institute for Medical Research, and founded the *Journal for Experimental Medicine,* carried great weight, and to him largely belongs the credit for the establishment of full-time professorships and the present most creditable status of scientific medicine in this country.

The American temple of medicine is rapidly fulfilling the hope and expectation of every patriotic citizen, thanks to the generosity of the Rockefeller, Carnegie and numerous private foundations. Some of the most difficult and important problems have been solved, and these achievements have already attracted foreign professors and students, but the temple is unfinished, and to you members of this association and all other research workers the spirit of American genius cries, rear it upwards, upwards to the skies.

In addition to all we owe to Dr Welch as the Father of Scientific Medicine, we are also greatly indebted to him for his example in the promotion of general culture in the languages, fine arts, poetry and literature His recent acceptance of the Professorship of Medical History at Johns Hopkins University, is by no means fortuitous. No less than thirty-five contributions to Medical History, indited by his graceful pen, eloquently attest his great interest and fitness for the perpetuation of the memory of great men and noble deeds.

He probably accepted an endowed professorship, so that the good work in this field may be carried on effectively also in this country and thereby stimulate the younger members of the profession to perform deeds worthy of permanent preservation.

In conclusion, my good and beloved friend, let me tell you how much we older members of this association are indebted to you, we have sat at your feet and imbibed words of wisdom and knowledge. The present and future generations of our Association will profit equally well by the perusal of the three volumes of important contributions and addresses, the product of your bright and fertile mind, and it will be their duty and privilege to see that your life and work shall know no death

It has been truly said that a single flower in a man's buttonhole is worth a ton of roses piled upon his grave. It is therefore a great pleasure to present to you the Association Medal for Research in Scientific Medicine, with the fervent hope that your days of usefulness and bliss may still be many, and that memories of this occasion may linger with you through the evening of life, and like the flowers that bloom in the sunlight spread their fragrance on your path

REMARKS OF WILLIAM H. WELCH[3]

Mr. President, Dr Kober, Members of the Association:

I beg to express my deep appreciation of the distinguished honor conferred upon me by the award by this Association of the Kober Medal for Research in Scientific Medicine provided by the Kober Foundation of Georgetown University and accompanied by its diploma.

It adds greatly to my pleasure to receive this medal directly from the hands of my dear friend for well nigh forty years, Dr George M Kober, the generous and eminent creator of this foundation. With his accustomed grace, even if in words all too generous in their estimate of the work and service of the recipient, he has performed the function, unusual and, it may be, difficult for a donor, of attempting to justify the action of the association in the bestowal of the medal I wish time and occasion were suitable for me to say something of Dr Kober's own important contributions and services to medicine, surgery, hygiene and public health and charities, and indeed I can not refrain from at least expressing here publicly what others as well as I have urged upon him in private conversation—the earnest wish that he should give the profession as well as the public the benefit of an autobiographical narrative of a long and unusually varied, interesting and useful life

My pleasure on this occasion is still further heightened by the circumstance that the award of this medal is by this Association of American Physicians, for I was present not only at its birth, but, I think now as the sole survivor, also at its conception, when, if my memory serves me correctly, in January, 1886, a small group of physicians, which included Osler and Pepper from Philadelphia, Francis Minot and Fitz from Boston, and Draper and Kinnicut from New York, were invited to meet in the office of Francis Delafield in New York to consider the desirability of founding a national association of the character realized six months later and of selecting the first founder members Only those familiar with the factional troubles, the disturbed professional conditions and the general state of medical education, science and art in this country at that time can realize the full significance of the brief introductory remarks of the first president of the association, Dr Delafield, who had in eminent degree the gift of multum-in-parvo speech, when he expressed our purpose to create a society without medical politics and without medical ethics, where no one cared who the officers were and where one would find fellow-workers in medicine and pathology understanding and capable of intelligently discussing the papers presented, and from whom one could learn. I need not tell you at this forty-second annual meeting that the hopes and wishes of the founders have been fulfilled beyond all expectation in the history of this association, membership in which still remains the high ambition of aspiring young clinicians and pathologists in spite of the later creation of many specialized national societies, not a few of these being offshoots from this parent stem.

Whatever may have been the illusions of those responsible for the bestowal of this medal inscribed as "Awarded for research in scientific medicine," I honestly believe that I am myself under no illusion on this score I am glad that Dr. Kober has referred to my three years of preparatory graduate study in Germany and to my masters, to whom I owe an inexpressible debt of gratitude, Waldeyer, Recklinghausen, Hoppe-Seyler, Ludwig, Wagner, and above all Cohnheim, and later Robert Koch and Flugge, and to the friendship continued from my student days throughout their lives with Weigert and Ehrlich.

Few have been so fortunate in coming provided with scientific wares from sources such as these upon a scene so ripe for educational and scientific advance and at a time so pregnant in the history of scientific medicine and in finding opportunities so favorable, yes, even hungry for disposal of their wares, however meager these opportunities and these wares may appear in these more favored times, as I had the good fortune to find from 1878 for six years in New York and later and better up to the present day in Baltimore Few have been more blest with the good will and support of their professional brethren and none more aided by colleagues and by a long line of devoted and loyal assistants and pupils, whose companionship and subsequent success have been the joy of my life

Last week I saw at the National Academy of Sciences the demonstration by General Carty and Mr. Ives of television, and, if I correctly understood the principle, the seen image comes solely from a multitude of spots of light reflected from the object, whose self-luminescence, if present, appears only as darkness. In citing this example of reflected radiance as applicable to the individual whom you are honoring on this occasion, I trust that I shall not be interpreted as claiming any share in the later achievements of assistants, associates and pupils such as those of that distinguished line of pathologists who became first assistants in my pathological laboratory—to mention only these—beginning with Hermann Biggs, later my successor in the New York laboratory, and continu-

[3] At the session of the Association of American Physicians in Atlantic City on May 4, 1927

ing in Baltimore with Councilman, Flexner, Barker, MacCallum, now my successor, Whipple and Winternitz.

To you, young men in this audience, to whose scientific papers I have listened with such delight and instruction, an *apologia pro mea vita*—my antiquity is revealed by my Latin pronunciation—would contain a far more useful message for me to deliver than to figure as an example, but on this score here and now I can only plead changed times and conditions no longer calling upon an investigator for activities which may once have seemed desirable.

I should, however, like to claim the privilege of years and of experience in addressing to the younger investigators a few words of advice and of precept, not conspicuously exemplified in my own career, which, though they may be trite, are not, I conceive, needless of emphasis under present conditions

Allow nothing to divert you from your professional and scientific work. While maintaining a spirit of cooperation, resist the call to give general addresses, especially at a distance from home, to serve on committees, to assume time-consuming administrative duties and to show visitors around laboratories, clinics and buildings. The active scientific investigator should be at least as inaccessible to the intrusion of casual visitors as the financier or the railway president Interruption beyond two or three years of investigative work is likely to be fatal to its successful resumption If you have found your problem it should absorb you, and its successful pursuit should make you the happiest of mortals in the consciousness of adding something to the body of ordered knowledge Strive for and be content with a scientific reputation based upon the judgment of the best workers in your own field, usually a relatively small group. Such reputations are enduring and often unrelated to merely local or even general professional reputations

Investigators are usually, although not always, the most stimulating teachers, but it should be more widely realized that students in our American medical schools suffer from over-teaching. It is quite as important that educational and scientific institutions should learn how promising investigators may be and often are spoiled, and to protect them as their most precious asset, as it is to provide facilities for research. I firmly believe that the productive years of scientific discovery may be greatly prolonged by recognition and remedy of conditions which at present too often and unnecessarily shorten them

I have, I fear unpardonably, encroached too long by these remarks upon this morning's program of scientific papers. Permit me to close by renewed expression of my grateful appreciation of the signal honor of enrollment among the Kober medallists.

THE PRODUCTIVE CAPACITY OF A UNIVERSITY[1]

RICHMOND COLLEGE is a name long familiar to me, for its baseball teams often visited our campus at Chapel Hill when I was connected with the University of North Carolina. Its buildings were familiar through annual visits to Richmond for our football game with Virginia—visits begun always in high hopes of victory and ending all too frequently with a dolorous return after defeat.

Knowing the Richmond College of former years, I was immediately struck with the name University of Richmond on the invitation to take part in these exercises Securing copies of the catalogue and pamphlet announcements, I rejoiced over the views of the beautiful buildings, constructed and in contemplation; the extension of its teaching of women at Westhampton College, the Schools of Law and of Business Administration, the summer school, and other evident lines of activity

Having noted the new title "University of Richmond" I naturally looked for an account of its graduate school This was found to be very limited. May I congratulate the authorities of the university on making no false pretenses in this matter, and in not undertaking work of a more advanced character until the foundation work of the undergraduate departments is thoroughly developed, and adequate facilities have been provided in which the best type of graduate work can be undertaken

I feel confident, however, that not only the faculty and the board of trustees, but also all those who have supported and will support this institution, agree that if this university is to measure up to the full realization of its name, all hands should be joined in bringing about the development of a graduate department which will equal in the sterling character of its training the work now given by the collegiate schools

On this occasion I should naturally prefer giving an account of the remarkable achievements in recent years in the field of chemistry, but your problem, as I see it, is a much broader one than chemistry alone. It is fitting, therefore, that we dwell for a short while on the thought of the productive capacity of a university in the full significance of that term. An institution must send forth men and women trained in the methods and imbued with the spirit of research; through the publication of the results of such research it must make its contribution to truth and to the ever-widening bounds of human knowledge.

I note that you contemplate raising an additional fund for endowment It may be helpful to remind

[1] Address delivered at the dedication of the new chemistry laboratory of the University of Richmond, Virginia, April 11, 1927.

ourselves at this time that when he was entrusted with the wise expenditure of a bequest for the foundation of a university, President Gilman, in his plans for Johns Hopkins University, thought only incidentally of buildings, his main care was to secure outstanding men who through their work with advanced students would create a true university in its highest sense His success marked a new era in our conception of university training.

The presence of an active graduate school has its stimulating effect upon that undergraduate training which you are now trying to perfect. It removes effectually any disposition in the undergraduate mind to consider thought or knowledge as static Where research is in progress, undergraduate courses lose all semblance of routine and take on a new significance as foundation work for the higher training which is necessary if one's future is not in all probability to have definitely fixed limitations

In the graduate school there is training in searching the literature of any subject, in formulating problems with precision, in the careful gathering of facts, in making fair deductions through accurate reasoning and in publishing results in understandable form. Such work and its publications constitute the second productive capacity of a university Moreover it is an obligation, for the university must through productive scholarship contribute its addition to that great fund of knowledge which makes for human progress.

Men and women trained in this atmosphere, no matter what the thesis subject may have been, possess an equipment which will enable them to undertake any problem with reasonable hope of its solution There is a tremendous demand to-day for those so trained. We have landed full head-on into the age of research in America

Eight years ago when the men in the Chemical Warfare Service had been demobilized and many of them were seeking in vain for positions, I wrote an editorial urging those who had not received a Ph D degree to return to their universities, no matter at what sacrifice, and complete their graduate training, for the country would need them Many leaders in chemistry at that time criticized the editorial on the ground that if the plea were heeded, there would be a surplus of such trained men. Time, however, has told a different story Last year at the meeting of the American Chemical Society in Philadelphia I made inquiry of the heads of the chemistry departments of many of our universities, and the answer was the same in every case They told me that they had turned out more Ph D men that year than ever before, nevertheless, it would have been easily possible to place double the number of men had they been available. Both universities and industries are seeking doctors of philosophy.

The factors which have brought about this wide expansion of research activities are numerous, but there are certain outstanding influences to which I would like to call attention. Because of acute shortages during the war period, the story of coal-tar and the thousands of products made from it gripped the imagination of the public All through this story there stood out preeminently the great rôle research had played in this remarkable development in a foreign land To build up that industry in this country, research was again emphasized, and the results were remarkable It was a true romance of modern industry.

For many years there had been fine research departments in some of our most important corporations, such as the General Electric Company and the Eastman Kodak Company Unfortunately, however, the real story did not get across until suddenly the country awoke to the fact that wood (methyl) alcohol, which for many years had been made here by destructive distillation of wood, was threatened by the importation of large quantities of synthetic methyl alcohol (methanol). The daily press handled the story extensively, and again the great value of research in industry was advertised. Just then, at the psychological moment, a series of articles entitled "What Price Progress?" appeared in the New York *Commercial*, written by Hugh Farrell, its financial editor These articles were printed in pamphlet form by the Chemical Foundation and given wide distribution This was no technical treatise, but a vivid portrayal of how industries which had followed the lead of research had prospered and how oblivion had waited for those who did not make use of this great agency of modern progress Finally the many investors throughout the nation opened their eyes, and the spirit of research was in the atmosphere

Along the same line, but going deeper to the roots of the matter, was a front page story, appearing one day in the newspapers all over the land, bearing an appeal from Secretary Hoover and a committee of nationally known men, urging voluntary contributions for a fund of two million dollars annually over a period of ten years, for the support of research in pure science in American universities. This appeal was made to business men as a wise investment, on the ground that progress in applied science is conditioned by and dependent upon progress in pure science. In that statement Secretary Hoover, head of the great business department of our government, did not hesitate to state: "The laws discovered by pure science are the basis of applied science and all industrial development."

In similar vein, the Secretary of Agriculture, Mr Jardine, has, within the last fortnight, stated in his public address at New Haven that, "men were not laying enough emphasis on pure science in proportion to our emphasis on the application of science and were not stimulating and training an adequate personnel in scientific research." Secretary Jardine further stated "the agriculture of the future will be successful in proportion to the extent to which it is shaped and guided by the basic facts revealed by scientific research, especially research in the fields of natural science, economics, engineering and business administration"

Research is truly the word to-day, not as a momentary fad, but as a permanent addition to our national equipment Within the last week, two striking announcements emphasized in what important ways this new tool is being utilized The morning papers of April 7 carried the announcement of a new policy by the largest of all our corporations, which is taking definite steps toward the creation of a great department of scientific research, the papers of Friday morning carried an appeal for a fund of $2,000,000 to be used for the benefit of the lepers in the Philippines, not for grounds and buildings where segregated they may pass away the remainder of their lives, but for research and equipment which will go to the root of the matter and drive out this dread scourge from among men

The South is profiting to-day at every turn by the research which is adding so constantly to science and to the efficiency of industry As a Southerner I have rejoiced over the news of the great industrial developments in the South and the many evidences of increase of wealth. Then I asked myself this question, "What contribution, in turn, is the South making to research in both pure and applied science?" To answer this question fairly, I have used methods of research and have gone over carefully the *Journal of the American Chemical Society* and *Industrial and Engineering Chemistry*, the publications of our national organization of chemists, and listed by states the origin of all the research articles published in these two journals last year From this study (Table I) it was found that from the thirteen states south of the Potomac River, namely. Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Arkansas, Tennessee and Kentucky, there have appeared among the four hundred and twenty-seven contributions to pure science in the *Journal of the American Chemical Society* only twenty-two articles from these states, just 5.2 per cent. Of the two hundred and eighty-four reports of scientific work in *Industrial and Engineering Chemistry*, only twelve were from these states, just four per cent. I regret to

TABLE I

Total Contributions of Results of Scientific Work, in A. C S. Journals, 1926

	From U. S	From 13 Southern States	Per cent.
J. A. C S	427	22	5 2
I & E Chemistry	284	12	4.0
Total	711	34	4.8

Contributions from Universities in U S

	From U S	From 13 Southern States	Per cent.
J A C S	348	22	6.3
I. & E Chemistry	103	5	4 8
Total	451	27	6 1

record that from the states of West Virginia, South Carolina, Georgia, Alabama, Mississippi and Louisiana not a single contribution was made. I regret to recall that among the three hundred and forty-eight contributions from university laboratories printed in the *Journal of the American Chemical Society* in 1926, there is not a single communication from a university in any of the following Southern states: West Virginia, South Carolina, Georgia, Alabama, Mississippi and Louisiana. Of the many contributions to applied science in *Industrial and Engineering Chemistry*, there is not a single paper from a university in the following states West Virginia, Virginia, South Carolina, Georgia, Florida, Alabama, Louisiana, Texas, Arkansas and Kentucky.

I shall make no effort to assign the blame for this deplorable state of affairs, whether it be shortsightedness of legislatures or penuriousness of men of wealth in the South, the lack of understanding by the executives of our Southern institutions, or the deep rut of routine into which professors have without adequate remonstrance allowed themselves to be thrown

One thing is certain, it is time for an awakening and for a wholehearted union of forces and of effort in order that this great section of our country should meet its full obligations and take its proper place in the progress of America.

May the University of Richmond, situated in this great city of the new South, soon find itself in position to contribute its full quota to the research output of the nation and to offer to the men and women who come within its walls a future of unbounded possibilities.

CHARLES H HERTY

THE CHEMICAL FOUNDATION,
NEW YORK, N. Y.

ADDISON EMERY VERRILL: PIONEER ZOOLOGIST

IN an attempt to gain some conception of the zoological influence of the life work of Professor Addison Emery Verrill, whose death occurred on December 10, 1926, there is brought to mind the enormous progress which has been made in the science of zoology during his lifetime Beginning his scientific studies at the time of the arrival of Louis Agassiz in this country, bringing with him the concepts of comparative morphology which were commencing to supplant the earlier systematic work in Europe, Verrill was able to follow the entire course of zoological progress to its culmination in the experimental methods of the present day.

Although Verrill did not directly participate in these more modern phases of biological research, he fully realized that much of the more recent work has been possible only because of the foundations laid by a small group of able men who, since the middle of the last century, have explored the vast fields containing previously undiscovered forms of life and have thus made known the morphology, natural history and relationships of the organisms available for more specialized and experimental investigation

Among these pioneer zoologists the name of Verrill stands out prominently because of the amount and accuracy of his contributions to our knowledge of marine invertebrates More than a thousand species, including representatives of nearly all groups, were discovered and described by him, and their relationships to previously known forms were diagnosed with almost unerring accuracy and with a facility that amounted almost to genius.

He was much more than a systematic zoologist, however, he was a real naturalist in that he was always interested in the natural history of the animals which he studied as well as the morphological characters which distinguished the species new to science His work on the natural history of the marine invertebrates of southern New England was the first extensive ecological study of its kind in America, and his Vineyard Sound report (published in 1871) was the standard reference book for all students of the seashore life of the region for more than thirty years.

Entering Harvard as one of the early pupils of Louis Agassiz, young Verrill, even while an undergraduate student, explored zoologically and geologically the island of Anticosti and parts of the coast of Labrador Receiving his bachelor's degree at Harvard in 1862, he remained as assistant to Agassiz in the Museum of Comparative Zoology, for two years a position in which he had already served while still an undergraduate. During this time he made a comprehensive study of the radiate animals and systematized the classification of the coelenterates.

In 1864 Verrill was called by Yale to bring to that institution the new science of zoology as developed by Agassiz and to serve as her first professor of that subject This position he held for forty-three years, until his retirement in 1907, at which time he was made professor emeritus.

When appointed at Yale he was but 25 years of age, having been born at Greenwood, Maine, February 9, 1839 It is perhaps needless to state that a naturalist of such exceptional ability in his manhood exhibited similar talents in his boyhood. At the age of thirteen he had learned to recognize the minerals and rocks of his native town He later made a collection of nearly a thousand species of plants, each of which he remembered throughout the remainder of his life, and at seventeen he began a collection of the local shells, insects, amphibia, reptiles, birds and mammals, making the identification, when possible, with the aid of such few books as were available and noting especially the kinds which were different from any described in his books In this way, and wholly without other assistance, he laid a broad foundation for the taxonomic studies which were to constitute his life work These boyhood studies in natural history began to bear fruit in the years 1862 and 1863 when he published no less than twenty-two papers, of which two were on minerals, one on plants, three on corals and their allies, seven on birds, four on animals, three on amphibians and the others on general natural history Most of these were brief taxonomic papers or lists of species, but one of them, on the revision of the Polypi of the eastern coast of the United States, showed a remarkable comprehension of the principles of taxonomy.

In 1871, when the United States Fish Commission inaugurated a comprehensive survey of the waters off the coast of New England with the object of securing information regarding the environment of the commercial fisheries, Verrill was selected as the logical person to take charge of the scientific investigations. And from that time until 1887 there came into his hands an almost continual stream of material dredged from the ocean bottom and containing a great number of forms of animal life quite different from any that had been previously known These were busy years, with numerous publications describing the new things that were discovered, and before the work was discontinued the Peabody Museum at Yale had become the repository of hundreds of thousands of specimens, among them being several hundred species previously unknown.

Instead of distributing this mass of material to specialists as is the rule at the present day, Verrill

covered all the groups of invertebrates except the protozoa, and it was his intention to summarize the results of his extensive studies on the marine invertebrates of the New England coast by writing a monograph on each group. Several groups were completed and published, but other manuscripts, with hundreds of drawings, were left unfinished at the time of his death.

For his was the spirit of the pioneer, ever seeking new forms of animal life for study, and having exhausted the more interesting forms from New England he next turned his attention to the Bermudas, making three trips to the islands. In 1901–1902 he published two volumes, containing not only the results of his studies in his special field, but also a brief historical survey of the settlement and social colonial development of the islands, their physiography and geology, and the effects of civilization on the native flora and fauna, the whole forming a very comprehensive summary of the natural history of this popular vacation land

For nearly twenty years after reaching the retiring age limit, in 1907, Verrill continued his studies with unabated energy, publishing in this period a series of papers which constitute in many respects his most important contributions to science These reflect his maturity of judgment and his accumulated knowledge from so many years of research

These works summarize his knowledge of the corals and allied animals, the starfishes and allies, and the crustacea, covering more than a thousand pages and illustrated by some two hundred plates Some time before his death he had placed in the hands of the publishers his most extensive monograph, on the Alcyonaria, consisting of upwards of a thousand pages and 150 plates. There is also awaiting publication a report on the crustacea of Connecticut with over a hundred plates A more detailed summary of his contributions to zoology and a condensed bibliography of his publications may be found in the *American Journal of Science*, May, 1927

Verrill's work was continued almost uninterruptedly until the last few weeks of his life. Even at the age of eighty-five, still sturdy and vigorous, he embarked on a new voyage of discovery on Kauai Island, in the Hawaiian group, with all the enthusiasm that he had shown when Agassiz sent him to Labrador and Anticosti in his student days. Two years spent at that island, and nearly a thousand lots of marine invertebrates were collected, including numbers of the new species which he was seeking His remarkable vitality, however, was at last exhausted and after bringing the collection back to New Haven he was unable to complete its study. In the autumn of 1926 he left for California to spend the winter with his son, but he died a few weeks after his arrival. He was within two months of having completed his eighty-eighth year

His publications extended over a period of forty-four years. During this long period of activity he published more than 350 papers on geological and biological subjects, making known to science more than a thousand new species of marine invertebrates, and revised the classification of almost every group. That he was able to accomplish so much is due not only to the very unusual number of years that he was able to work, but also to his ability to continue the most arduous mental tasks for many hours each day, with never a thought of recreation and an almost incredible minimum of sleep That his diagnoses were so accurate and that he could cover so wide a field is due in part to his marvelous memory, he seldom forgot anything of importance connected with his work and could recall the characteristics of almost every one of the thousand animals to which he had given names

The definition of all the zoological terms in the 1890 edition of Webster's International Dictionary were prepared by Verrill, and by him the hundreds of accompanying illustrations were selected. One can hardly open this great volume without having before his eyes testimony of Verrill's remarkable breadth of scholarship.

For forty-five years (1865–1910) he was in charge of the zoological collection belonging to Yale University Through his agency the collections increased from almost nothing to one of the most extensive in any university museum in the country

The honorary degree of M.A was conferred upon him by Yale and he was honored by being appointed lecturer at the Lowell Institute in Boston in 1899 He was a member of the National Academy of Sciences, for some years president of the Connecticut Academy of Arts and Sciences, a corresponding member of the Société Zoologique de France, a fellow of the American Association for the Advancement of Science and a member of many learned societies From 1869 to 1920 he was associate editor of the *American Journal of Science* and he served as professor of comparative anatomy and entomology at the University of Wisconsin in 1868–70 and as a curator of the Boston Society of Natural History for some years, in addition to his professorship at Yale.

In 1865 Professor Verrill married Flora Louisa Smith, a sister of the late Professor Sidney I. Smith, of Yale. Mrs. Verrill died in 1915 Four of their six children survive, the two sons being Major George E. Verrill and Alpheus Hyatt Verrill.

WESLEY R. COE

YALE UNIVERSITY

SCIENTIFIC EVENTS

AIRPLANE VIEWS OF SOUTHEASTERN ALASKA

In order that the "phototopographic" views made in southeastern Alaska last summer by the Navy Department at the request of the Geological Survey may be available to the general public at as early a date as possible, arrangements have been recently entered into between the Geological Survey of the Interior Department and the Forest Service of the Department of Agriculture whereby prints of the pictures may be obtained at a small price. It should be distinctly understood, however, that several prints of adjacent areas can not be joined so as to form an undistorted mosaic

Nearly 5,000 sets of exposures were made during the summer, each consisting of three parts—a central picture which represents the ground directly under the airplane and two side pictures which represent adjoining areas on each side of the central picture The central picture is taken with a camera pointed vertically downward, and the two side pictures are made at the same moment by two supplementary cameras directed obliquely to each side and fixed at a definite angle to the vertical A set of three pictures thus taken represents an area of about 11 square miles when the plane flies at the preferred elevation of 10,000 feet, and the whole series covers practically all of southeastern Alaska except Baranof and Chichagof Islands

As rapidly as possible official sets of all the prints will be made, and one set will be placed on file for inspection in the district office of the Forest Service at Juneau, Alaska, and another in the office of the Alaskan branch of the Geological Survey, at Washington, D C More than one half of the prints have now been completed, and it is hoped to have the entire set ready by October 1 Orders for prints may be made by number from these file sets Those to whom these file sets are not readily accessible may request from the Forest Service, Washington, D C, a copy of an index map which shows the location of the area covered by each photograph or may forward orders specifying the location of the precise tract of which photographs are desired, the name of the island on which the tract is located, and the size of the tract

OCEAN WEATHER CHARTS

Preparation of complete ocean weather charts and dependable forecasts every day for the benefit of aircraft navigators, as well as masters of water craft on the North Atlantic, is a project which the United States Weather Bureau hopes to accomplish within the near future.

The transatlantic airplane flights have stimulated the receiving of ocean weather reports, enabling the bureau to keep the recent Byrd flight well advised as to the winds, storms and fogs which would be encountered in the crossing. This service was made possible largely by the voluntary cooperation of shipmasters and of the radio companies, which collected the ocean weather information twice daily and delivered it to the bureau for charting and analysis

In future transatlantic flying such voluntary cooperation will hardly be as readily forthcoming since the novelty of the enterprise will be gone and public interest less keen Officials of the Weather Bureau are accordingly figuring out what can be done to stimulate interest in ocean weather reports to add to the safety of flying and of navigation It is their hope that shipmasters will continue the work when the present flying season is over Nevertheless, something more permanently dependable is essential

That a more complete and extensive organization of the ship service is necessary is shown by the fact that on some days while the fliers were waiting for favorable conditions the Weather Bureau did not get a single ship report from areas a thousand miles wide in the Atlantic Even on May 18, two days before Lindbergh made his successful flight, no report was received from any ship between midocean and the Irish Coast. It was not until he had started that weather reports from ships became nearly adequate When Chamberlin made his flight the amount of information coming in was more abundant than in any previous period.

Eventually, when funds and facilities permit, the Weather Bureau hopes to get reports twice daily from all ships in the Atlantic lanes Such reports, supplemented by reports from land stations in this country, Canada, Greenland, Iceland and Europe, would make possible the preparation of complete ocean weather charts and dependable forecasts every day.

THE ASTRONOMY AND PHYSICS CLUB OF PASADENA

The following is the program of the Astronomy and Physics Club of Pasadena for the last half year:

January 7. Series Spectra of Boron, Carbon, Nitrogen, Oxygen and Fluorine Dr. I S. Bowen.

" 14, 21, 28. Statistical Mechanics Dr. R. C. Tolman

February 4, 5 Conference on the Michelson Morley Experiment Dr A. A. Michelson, Professor H. A. Lorentz, Professor D. C Miller, Professor E. R. Hedrick, Professor P. S. Epstein, Dr R. J. Kennedy. (A complete report of this conference will be published later)

" 11 The Electrostatics of the Thunder Storm: Dr. A W. Simon, National Research Fellow.

February 17, 18 The New Quantum Mechanics. Dr E Schrödinger, professor of mathematical physics at the University of Zurich
March 4. The Theory of the Breakdown of Dielectrics Professor A. Joffé, of the Physical Technical Roentgen Institute of Leningrad
" 11. Some Characteristics of Solar and Stellar Atmospheres Dr Charles E St John
April 1 Doublet Separation and Fine Structure of the Balmer Lines of Hydrogen Dr Norton A. Kent, professor of physics, Boston University
" 8 Absolute Intensities of Lines in the Pure Rotation Spectrum of HCl. Dr R M Badger
" 18 "Newton" Professor H H Turner, of Oxford University, England
" 22 The Scandium Spectrum Professor Henry Norris Russell, of Princeton University
" 29 Theory of Precision Clocks and other Regenerative Systems Mr V H Benioff
May 6 On the Theory of Compton Effect Dr P S Epstein
" 13 Recent Research in Line and Band Spectra Dr L A. Sommer, of the University of Göttingen
" 20 The Theory of the Davisson Germer Experiment Drs. C Eckart and F Zwicky
" 27 The Shift of Spectroscopic Lines with Pressure Mr H D Babcock
June 3 Some Evidences as to the Ultimate Nature of Magnetism T D Yensen Photo electric Fatigue F. L Poole

THE INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION

THE list of delegates and guests of the American Geophysical Union to the third general assembly of the International Geodetic and Geophysical Union which meets at Prague from September 3 to 10, includes:

Dr Louis A Bauer, director, Department of Terrestrial Magnetism of the Carnegie Institution of Washington, accompanied by Mrs Bauer

Dr William Bowie, chief of the division of geodesy of the U S. Coast and Geodetic Survey, accompanied by Mrs Bowie and their adult son.

Dr. J H Dellinger, senior physicist of the radio section of the U S. Bureau of Standards, accompanied by Mrs. Dellinger

Commander N. H Heck, chief of the division of terrestrial magnetism and seismology, U S Coast and Geodetic Survey.

Mr. W. D. Lambert, mathematician of the division of geodesy, U. S. Coast and Geodetic Survey, accompanied by his sister, Miss Mary B. Lambert.

Dr. R. A. Millikan, director of the California Institute of Technology, Pasadena

Dr. Harry Fielding Reid, professor of dynamic geology of the Johns Hopkins University, Baltimore.

Professor L C. Graton, of the department of geology, Harvard University, Cambridge, Mass, will attend as a guest

The following resolutions were adopted by the American Geophysical Union during its eighth annual meeting on April 29:

RESOLUTIONS ON TRANSLATIONS OF REPORTS ON SEISMOLOGICAL INVESTIGATIONS PUBLISHED IN THE JAPANESE LANGUAGE

(Submitted by Section of Seismology)

Whereas, It has become known that the reports of much of the seismological investigations carried on in Japan will hereafter be published in the Japanese language only, and

Whereas, This procedure is calculated to deprive most of the American students in this field of research of the advantages of this literature, be it

Resolved, That this matter be brought to the attention of the National Research Council in the hope that the council may provide that this literature be rendered into English, also that provision be made whereby mimeographed copies of these translations be supplied investigators at research institutions gratis and to business concerns, insurance companies, and others interested at cost, and

Resolved, Further, that, should such an arrangement be feasible, a committee of the Geophysical Union be empowered to make a choice of the material to be so translated and distributed

THE BUREAU OF CHEMISTRY AND SOILS OF THE U S DEPARTMENT OF AGRICULTURE

DR CHARLES ALBERT BROWNE, chief of the bureau of chemistry of the United States Department of Agriculture, has been designated acting chief of the new Bureau of Chemistry and Soils, which takes form July 1 Dr A G McCall, of the University of Maryland, has been selected to head the department of soils and will take the place of Professor Milton Whitney, who has headed this work since its organization in the department, but who is now obliged, on account of ill health, to relinquish exacting administrative duties Professor Whitney will devote himself to writing up results of important investigations on which he has been engaged for many years

A. G Rice, assistant to the chief of the Bureau of Soils, has been given the same position in the new bureau.

Dr. McCall was a member of the scientific staff of the Bureau of Soils from 1901 to 1904. He left the Department of Agriculture to become assistant professor of agronomy in the Ohio State University and was soon made head of that department, holding the position until 1916 when he became head of the de-

partment of soils and geology in the University of Maryland.

Maryland was the first state to start soil survey work and the first to complete it. The work was started under Professor Milton Whitney and completed under Dr McCall

Dr McCall received his B Sc degree from the Ohio State University in 1900 and his Ph D from the Johns Hopkins in 1916 He is a member of the Society of Agronomy, the American Association for the Advancement of Science, the Society for the Promotion of the Agricultural Science, and of many other scientific and agricultural organizations. He was executive secretary of the First International Congress of Soil Science recently held in Washington, and has been active in promoting soil science as a writer and investigator.

The new Bureau of Chemistry and Soils combines the research divisions of the old Bureau of Chemistry, the Bureau of Soils, and the Fixed Nitrogen Research Laboratory The regulatory work formerly carried on by the Bureau of Chemistry has been combined with the regulatory work in the Insecticide and Fungicide Board and all will be administered in the new Food, Drug and Insecticide Administration

The Civil Service Commission recently held an examination for the position of chief and assistant chief of the newly created bureau From the list of eligibles the secretary of agriculture expects soon to select the permanent head Dr Browne has expressed a desire to devote his energies to chemical research, but has consented to handle the general administrative work temporarily

SCIENTIFIC NOTES AND NEWS

Dr. Eliakim Hastings Moore, professor of mathematics in the University of Chicago, a past president of the American Association for the Advancement of Science, has received the degree of doctor of science from the University of Kansas Northwestern University, where Dr Moore was formerly professor of mathematics, also conferred on him the doctorate of science as "a productive scholar whose publications are marked by their originality, finished character and far-reaching significance, the recognized leader among American mathematicians"

The University of Michigan on the occasion of the recent commencement conferred the degree of doctor of science on Dr Alexander Ziwet, for many years professor of mathematics in the university and professor emeritus since 1925, and on Dr. Willis Rodney Whitney, since 1901 director of the research laboratories of the General Electric Company.

Dr. James M. Anders, professor of medicine in the University of Pennsylvania, received the degree of doctor of science on the occasion of the commencement exercises of Bowdoin College

Dr. Alexis Carrel, of the Rockefeller Institute for Medical Research, has been elected correspondent of the Paris Academy of Sciences in the department of medicine and surgery

At Princeton University Professor Edwin Grant Conklin has been appointed Henry Fairfield Osborn research professor of biology; Professor K. T Compton, Cyrus Fogg Brackett research professor of physics, and Professor Hugh Scott Taylor, David B Jones research professor of chemistry

Professor F G Donnan, professor of general chemistry in the University of London, has been elected a member of the Royal Academy of Sciences of Amsterdam, filling the vacancy caused by the death of Professor C Golgi, of Pavia.

The University of Oxford conferred the honorary degree of D Sc upon Sir Robert Hadfield, Bart., and Dr Richard Willstatter, professor of chemistry in the University of Munich, on June 30

Nature reports that the Senatus Academicus of the University of Edinburgh has agreed to offer the degree of doctor of laws to the following, for conferment at the special graduation ceremonial on July 20, on the occasion of the visit to Edinburgh of the British Medical Association· Lord Dawson, of Penn, physician in ordinary to His Majesty the King, Dr A. Donald (Manchester), Dr C E Douglas (Cupar), Sir William Hale-White (London), Mr R G Hogarth (Nottingham), Dr W Hunter (London), Dr T. H. Milroy (Belfast), Sir Berkeley Moynihan, Bart. (Leeds), Sir J H Parsons (London), Sir Humphry Rolleston, Bart (Cambridge), Dr G F. Still (London); Mr W. Trotter (London), Sir Almroth Wright (London), Professor Vittorio Ascoli, professor of clinical medicine, Rome, M Jules Bordet, director of the Pasteur Institute, Brussels; Dr Harvey Cushing, professor of surgery, Harvard University; Dr. C. L. Dana, professor of nervous diseases, Cornell University; Professor Knud Faber, professor of medicine, University of Copenhagen; Dr. Jan van der Hoeve, professor of ophthalmology, University of Leyden, Dr Otto Meyerhoff, professor of physiology, University of Berlin; Dr. Otto Naegeli, professor of medicine, University of Zurich; Dr. W. S. Thayer, professor emeritus of medicine, Johns Hopkins University, and M T. M Tuffier, Academy of Medicine, Paris.

The International Anesthesia Research Society presented on May 16 to Dr. Arno B. Luckhardt, professor

of physiology, University of Chicago, and T. Bailey Carter, D Sc, a scroll of recognition in appreciation of "meritorious research in anesthesia and analgesia, and for prolonged, untiring and resultful experimental laboratory studies of the biochemistry and pharmophysiopathology of ethylene, as well as such splendid cooperation of pure with applied science as enabled the surgeons, specialists and anesthetists of the Presbyterian Hospital (Chicago) to rapidly establish the clinical use of ethylene as a new and valuable routine method of anesthesia for the benefit of suffering humanity"

THE Cross of Knight of the Czechoslovak Order of the White Lion, a decoration for citizens of foreign states in appreciation of their services rendered on behalf of Czechoslovakia, has been awarded to the following American engineers by the Czechoslovakian Government Professor Joseph W Roe, head of the Department of Industrial Engineering, New York University, Calvin W. Rice, secretary of the American Society of Mechanical Engineers, Alfred D Flinn, director of the Engineering Foundation, New York, Lawrence W Wallace, executive secretary of the American Engineering Council, Washington, H S Person, managing director of the Taylor Society, New York, and Morris L Cooke, an industrial engineer of Philadelphia.

DR JOHN JOHNSTON, previously chairman of the department of chemistry of Yale University, on July 1 took up his work as head of the new research department of the United States Steel Corporation He intends to spend several months visiting various plants and studying metallurgical problems and practices, after which he will organize an adequate research laboratory It has not yet been determined where it will be established.

PROFESSOR ARCHIBALD VIVIAN HILL, F R S, who recently returned to England after having lectured during a semester in Cornell University, has been elected honorary fellow of King's College, Cambridge

SIR RICHARD T. GLAZEBROOK, formerly director of the British National Physical Laboratory, has been appointed a member of the Advisory Council for Scientific and Industrial Research.

DR. DONALD B. VAN SLYKE, of the Rockefeller Institute for Medical Research, has been elected president of the Harvey Society for the ensuing year.

THE recently elected officers of the American Society of Plant Physiologists for the year 1927–28 are: *President*, Charles A. Shull, *vice-president*, William E. Tottingham. The *secretary-treasurer*, elected last year for a term of two years, is Scott V. Eaton.

AT the annual meeting during the last week in June of the Society for the Promotion of Engineering Education at the University of Maine the following officers were elected *President*, R L. Sackett, Pennsylvania State College, *vice-presidents*, C E Magnusson, University of Washington, T E French, Ohio State University, *secretary*, F L. Bishop, University of Pittsburgh, *treasurer*, W O Wiley, of Messrs. John Wiley and Sons.

DR. GEORGE K. BURGESS, director of the Bureau of Standards, was elected president at the twentieth National Conference on Weights and Measures held at the Bureau of Standards from May 24 to 27.

PROFESSOR G S. WHITBY, of McGill University, has been elected president of the Canadian Institute of Chemistry for 1927–8

PROFESSOR THEODORE W RICHARDS, of Harvard University, and Professor James F Norris, of the Massachusetts Institute of Technology, have been appointed honorary chairman and honorary vice-chairman, respectively, of the committee in charge of the seventy-sixth meeting of the American Chemical Society, which will be held in September, 1928, at Swampscott, Mass, under the auspices of the Northeastern Section The general chairman is Dr Gustavus J Esselen, Jr, vice-president of Skinner, Sherman and Esselen, Inc, Boston, Mass, and the executive secretary is Professor Lester F Hamilton, of the Massachusetts Institute of Technology

AT the recent Annual Convention of the Association of Cereal Chemists held in Omaha the following officers were elected *President*, Mr Leslie R Olsen, The International Milling Co, Minneapolis, Minn, *vice-president*, Mr C E. Mangels, North Dakota Agricultural College, Fargo, N D, *secretary-treasurer*, Mr R. K Durham, The Rodney Milling Co, Huntzinger Bldg, Kansas City, Mo.; *editor of Cereal Chemistry*, Dr C H Bailey, University Farm, St. Paul, Minn., *business manager*, Mr. C. G Ferrari, University Farm, St. Paul, Minn. Mr Roland J Clark was appointed by Mr. Olsen as chairman of the Association's Committee on Publicity

AT a meeting of the Board of National Research Fellowships on May 27 and 28, the following additional appointments were made *Reappointments:* Bacteriology, Albert Haldane Gee, Botany, R E Girton, L. Joseph Klotz and Lewis E Wehmeyer; Psychology, Harry R. De Silva, M F Metfessel, R H. Seashore, Zoology, C. Dale Beers, Margaret R. Murray, E. A. Swenson and R. L Zwemer. *New Appointments*: Botany, James M. Fife, Frederick H Frost and M. B. Linford; Psychology, C. P. Heinlein and Louis William Max; Zoology, F. W. Appel, D.

R Briggs, F J Brinley, Robert H Luce and Jack Schultz.

DR. P W ZIMMERMAN, dean of the College of Agriculture at the University of Maryland, has accepted a position on the staff of the Boyce Thompson Institute for Plant Research at Yonkers, New York. He will have charge of the experimental work in vegetative propagation Propagation problems have become very urgent for American nurserymen and horticulturists, especially in view of the quarantine which will be in full operation by 1930

R. H BELL, who has been assistant director of agricultural extension work at State College, has been appointed director of the Bureau of Plant Industry in the Pennsylvania Department of Agriculture at Harrisburg

DR. RALPH C P TRUITT, director of the department for the prevention of delinquency of the National Committee for Mental Hygiene, has been appointed director of the clinic of the Mental Hygiene Society of Maryland, to which a grant of $23,000 was recently made by the Commonwealth Fund

MISS RUTH ATWATER, who for the last four years has had charge of the foods courses at Skidmore College, Saratoga Springs, New York, serving during the last year as director of the department of home economics, has been appointed director of the Bureau of Home Economics of the National Canners Association

DR CHARLES G ABBOT left Washington on June 1 for Mt. Wilson, California, where he will continue his work on the stellar energy spectra, and on the solar cooker He will probably return about October 1

THE Tropical Plant Research Foundation has undertaken an investigation of the physiology, bark anatomy, and latex flow of the sapodilla tree and tapping problems connected with the production of chicle, supported by the Chicle Development Company of New York Dr John S Karling, of the department of botany of Columbia University, is leaving for British Honduras to carry on the field work

PROFESSOR JOHN W HARSHBERGER, professor of botany in the University of Pennsylvania, sailed for South America on July 2, to conduct botanical study on the vegetation of that country He will visit the tropical rain forest, the Araucaria forest of Brazil, the pampa of Argentine, the high Andes of Chili, the Antarctic forest of southern Chili, and on his return homeward, attention will be given to the lomas of the west coast of Peru

DR. O A REINKING, pathologist of the United Fruit Company, Boston, has returned to the United States after two and one half years of exploration in the Philippine Islands, Southern Asia, India, Indo-Malaysia and Australasia relative to securing disease resistant varieties of bananas

PROFESSOR DR. A FUJINAMI, of the Kyoto Imperial University, has been appointed as exchange professor and has left Japan for South America to study sanitary conditions in Brazil

DR. Y SATA, formerly president of the Osaka Medical College, has been nominated exchange professor to Germany, and will give lectures on tuberculosis in several universities there He also carries several reels of films produced by the education department showing ancient Japanese martial arts

SIR FREDERICK KENYON delivered the Romanes lecture of the University of Oxford on June 17 He took as his subject "Museums and National Life."

DR. J. L COLLINS, of the division of genetics, University of California, has returned from Vancouver, British Columbia, where he was invited by the Canadian Society of Technical Agriculturists to deliver two lectures on Experimental Genetics and Genetics in its Relation to Breeding

DR JOHN B DEAVER, Philadelphia, was guest of honor at the dinner of Medico-Surgical Society of New York, on May 21, when he spoke on "Preventive Measures against Gastric Ulcer and Malignancy."

DR CHARLES E ST JOHN recently gave a lecture on "The Evidence and the Bearing of the Theory of General Relativity" at Amherst College, and at Cornell University under the Schiff Foundation He also spoke before the Physical Colloquium of Cornell University on "Some Characteristics of Solar and Stellar Atmosphere"

THE fiftieth annual convention of the Pennsylvania Forestry Association met at West Chester on June 28, under the presidency of Dr Henry S Drinker, president-emeritus of Lehigh University.

MR. GEORGE EASTMAN, of Rochester, has given $1,500,000 to establish a dental dispensary in London, England, which will be associated with the Royal Free Hospital. It probably will be much like the Rochester Dental Dispensary, Rochester, N. Y. The agreement provides that the British friends of the project raise funds to defray the running expenses of the institution The activities of the dispensary are to be confined to a definite district in London which has a population of about 600,000, mostly poor and middle class persons.

MR. J. PIERPONT MORGAN and Mr William H Matheson have provided funds for a world survey of epidemic encephalitis. With this object in view, a commission has been appointed consisting of Dr Haven Emerson, professor of public health administration, Columbia University College of Physicians and Surgeons, Dr. Frederick P Gay, professor of bacteriology, Columbia University College of Physicians and Surgeons, Dr. William H. Park, director, bureau of laboratories, New York City Health Department, Dr Josephine B Neal, director of research.

A 1,750-ACRE forest tract, situated not far from Ithaca, has been given to Cornell University by the heirs of Mathias H Arnot, of Elmira. The tract will be under the supervision and management of the department of forestry of the university and will be used for purposes of research, demonstration and instruction The major part of the tract is in Schuyler County, although its northern end is in Tompkins County It lies in the watershed of the Susquehanna River

A FIELD meeting of the Southern California Rift Club was held on Sunday, May 29, in the Narrows of the Cajon Pass between the San Gabriel Mountains on the west and the San Bernardino Mountains on the east. It was attended by over a hundred members and friends of the club, and was called to order by the president, Dr Levi F Noble, who introduced Professor J. P Buwalda, of the California Institute of Technology, at Pasadena. Professor Buwalda gave a general account of the great San Andreas rift belt, which traverses the pass obliquely from west-northwest to east-southeast, and on which a displacement in the San Francisco region caused the earthquake of 1906, he emphasized the numerous sub-parallel faults which the belt includes in its width of a mile or more, and explained that, in consequence of complex movements upon them, many great slices and slabs of rock, more or less crusted by the pressure and friction to which they have been subjected during their displacement, are now found in discordant relation to each other and to the rock on either side of the belt. Professor W. M. Davis, of Harvard University, next spoke with especial regard to the contrast between rifts of the San Andreas type, which have nearly rectilinear traces, and on which movements with a large horizontal movement seem to predominate, and rifts of the Wasatch type, traces of which show a succession of concave bights separated by cusps and on which movements with a large vertical component prevail Professor Davis also called attention to the importance of establishing monuments on the two sides of certain rifts at selected points, in order that future displacements may be detected After a picnic lunch, Dr. Noble led the party up the nearby mountain slope, whence the course of the rift for several miles in both directions was pointed out, and where several great rock slabs of diverse composition and of large displacement in the rift belt were examined.

THE first zoological garden for Prague is to be established in Troja, one of the outer suburbs. Plans for the completion of the buildings extend over many years, but the exhibition of birds and animals is to be completed as soon as possible Funds for this enterprise are being obtained partly by the formation of a company and partly by state aid The total is estimated at about 2,000,000 crowns.

THE authorities of the Province of Saskatchewan are making arrangements for the preparation of a comprehensive geological air survey of the northern part of that province, according to advices to the Department of Commerce from Assistant Trade Commissioner W J. Donnelly, at Montreal The project, it is said, will be undertaken for the purpose of determining the mineral wealth of the district to be surveyed and, when the maps are completed, the mineralized areas will be indicated as an aid to prospectors interested in that region

PRESIDENT COOLIDGE, by recent executive order, has set aside nine tracts of land in Alaska as game and bird preserves Certain areas along the Alaska Railroad have been set aside as a preserve and breeding ground for muskrats and beavers, and a tract of 14 square miles about the government hotel at Curry, Alaska, which is also on the railroad, a refuge for the protection of wild birds and game and fur-bearing animals. In the area at Curry fishing will be regulated by the secretary of commerce, and the hunting and trapping of birds and game and fur-bearing animals, other than brown and grizzly bears, wolves and wolverines, will be permitted only under regulations to be prescribed by the secretary of agriculture, in accordance with the Alaska game law

THE report of the committee presided over by Lord Lovat, which was appointed by the British Colonial Office Conference to make recommendations in regard to the establishment of a Colonial Scientific and Research Service, has been issued. The cost of such a service is estimated to be £175,000 a year The committee proposes that a council should be set up under a chairman appointed by the Secretary of State for the Colonies, a director and deputy director and the following members: The director of the Royal Botanic Gardens, Kew, the director of the Imperial Bureau of Entomology; the director of the Imperial

Bureau of Mycology, a chemist, a representative of veterinary science, a representative of the Imperial Institute, a representative of the Colonial Office, and a representative of the Empire Marketing Board The principal functions of the council would be to administer a Colonial Agricultural Research Service, which would include an Empire chain of research stations maintaining *liaison* with the Empire Marketing Board, the creation of a clearing house of information and the organization of a "pool" of scientific workers

UNIVERSITY AND EDUCATIONAL NOTES

THE Massachusetts Institute of Technology is named residuary legatee in the will of Henry P. Talbot, professor of chemistry, who died on June 18 Mrs Talbot receives $20,000, and is to have the income from the remainder and use of the home at 273 Otis street At her death the trust is to be terminated and after $83,000 in private bequests are paid the institute is to receive the residue While use of the money is not restricted, it is suggested that a part or the whole be used to assist junior instructors to attend meetings of societies representing their professions

YALE UNIVERSITY receives a bequest, said to amount to nearly $500,000 under the will of Charles Colebrook Sherman, the income to be paid to Mrs. Sherman until her death or remarriage, when it is to be used for the maintenance of a fellowship Mr Sherman also left his library to the university

AN additional gift of $250,000 for the building of the George Herbert Jones Chemistry Laboratory has been made to the University of Chicago by Mr Jones In December Mr Jones gave the university $415,000 for the chemistry building which is to bear his name, and his added gift will make possible a larger structure, with consequent extension of facilities

REORGANIZATION of the school of engineering at Oregon State Agricultural College has been effected by the board of regents with the establishment of an engineering experiment station and additional graduate work Dean G A Covell, for thirty-four years a member of the state college faculty and head of the school of engineering since its establishment, has been made director of the experiment station and dean of the graduate work S H Graf, professor of mechanics and materials, will be associate director Harry S Rogers, professor of hydraulics and irrigation engineering, formerly of the University of Washington, but for the last six years a member of the Oregon Agricultural College staff, has been advanced to the deanship of the undergraduate school.

AT the recent dedicatory exercises of the Montgomery Ward Memorial Building of Northwestern University Medical School, Dr. L. B. Arey was installed as the first incumbent of the Robert Laughlin Rea professorship of anatomy This chair was established by Mrs Mollie Manlove Rea in memory of her distinguished husband, who was held by his contemporaries as the foremost anatomical teacher of his time in the west Dr Sam L Clark, assistant professor of histology and neuroanatomy at Washington University Medical School, has accepted an appointment as assistant professor of anatomy

DR. EZRA J KRAUS, professor of botany in the University of Wisconsin, has joined the faculty of botany in the University of Chicago

DR. BURTON M VARNEY, of the U S Weather Bureau, has resigned from the assistant editorship of the *Monthly Weather Review* to accept an associate professorship in geography in the University of California at Los Angeles.

THE department of neuroanatomy and histology of the Washington University School of Medicine which was established in 1924 has been reunited with the department of anatomy, the union to take effect during the year 1928 Dr. Robert J Terry, professor of anatomy, will be in charge of the reorganized department

A. S BESICOVITCH, of the University of Leningrad, has been appointed university lecturer in mathematics at the University of Cambridge for three years.

DISCUSSION

THE CHATTANOOGAN AGE OF THE BIG STONE GAP SHALE OF SOUTHWESTERN VIRGINIA

IN 1924[1] the writer called attention to the fact that the Chattanooga black shale in the type area, Chattanooga and vicinity, Tennessee, is divisible into three parts: (1) an upper, thin black shale, (2) a central, gray clay shale, and (3) a lower, thicker black shale The outcrops of the shale were traced continuously to Lafollette, Tennessee, and Cumberland Gap, Virginia-Tennessee, where the tripartite division was again found. Last summer the writer was able, through the generosity of a grant from the Smith Fund of the University of North Carolina, to trace the Chattanooga shale from Cumberland Gap to the type locality of the Big Stone Gap shale at Big Stone Gap, Virginia. As a result of this study the following facts were brought out:

[1] *Amer. Jour. Sci.* (5) 7, 1924, pp. 24–26, 30.

(1) The Big Stone Gap shale is a northward extension of the Chattanooga shale of the type area.

(2) The Big Stone Gap shale shows the same tripartite division as the Chattanooga shale of the type area, except that all three units are considerably thicker.

(3) In passing from Lafollette to Big Stone Gap the middle gray shale member thickens up, replacing the uppermost part of the underlying black shale member

(4) The contact between the lower black shale and the gray shale is not a stratigraphic but an environmental break since the uppermost part of the lower black shale in the south interfingers with the gray shale which replaces it to the north. Thus both the gray shale and the replaced black shale are of the same age, differing only in the conditions of their deposition

(5) The lower black shale thickens by underlap in passing to the north, so that the lower black shale at Chattanooga is only the uppermost part of the lower black shale member As stated above, this uppermost part is of the same age as the middle gray shale member in southwestern Virginia.

(6) In Tennessee an unconformity separates the upper black shale from the underlying gray shale member This unconformity has not been demonstrated in southwestern Virginia.

The completed study will appear in a later paper

J H SWARTZ

UNIVERSITY OF NORTH CAROLINA

NOTES ON HELODERMA SUSPECTUM AND IGUANA TUBERCULATA

ON April 2, 1923, the writer received a poisonous lizard, *Heloderma suspectum*, from Wheelock, Robertson County, Texas This village lies in the southeast part of the county on no highway and about twelve miles from the nearest railroad. This animal had been killed by a farmhand as it was crawling about on his land, and was brought by a student to the department of biology of the Agricultural and Mechanical College of Texas The finding of this reptile in Robertson County so far from its native home is indeed interesting Ditmars,[1] Gadow,[2] Hegner,[3] Hornaday[4] and Pratt,[5] limit the distribution of these animals to Arizona, New Mexico and northern Mexico. Only one other occurrence of the Gila Monster in Texas is recorded in the literature available to the writer Cope[6] lists a specimen taken at Fort McDowell, Texas This single find was referred to by Strecker[7] who comments somewhat skeptically on the report and states that he made careful search in favorable localities for these reptiles, but failed to find them in Texas. Any attempt to explain how this lizard found its way to Wheelock, some four or five hundred miles from its native haunts, would be mere guesswork.

The writer has lately received from Mr L. T. Hunter, county agent, Childress County, Texas, another most interesting find—the common Iguana, *Iguana tuberculata* This reptile was killed on a roadside near Childress and was sent to the Agricultural and Mechanical College of Texas on December 20, 1926 Childress County lies close to the eastern border of the Panhandle of Texas, touching the southwest corner of Oklahoma. This find is even more remarkable than the former, since the iguana was much farther from its native home—tropical America The specimen measures three feet, nine and one half inches in length and apparently is only partly grown Gadow states that *Iguana tuberculata* attains a length of five or six feet. Ditmars, Gadow, Hegner and Hornaday give the distribution as Central and South America and the West Indies, where it lives in trees. How such a reptile could find its way from its tropical and arboreal habitat in the jungles to the almost treeless plains of Childress, Texas, is an interesting speculation.

PENNOYER F ENGLISH

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS, COLLEGE STATION, TEXAS

[1] Ditmars, R. L., "Reptiles of the World," 1922

[2] Gadow, H., "Amphibia and Reptilia," Cambridge Natural History, Volume 8.

[3] Hegner, R. W., "College Zoology," revised edition, 1926.

[4] Hornaday, W. T., "The American Natural History," 1904.

[5] Pratt, H. S., "Manual of the Vertebrates of the United States," 1923.

[6] Cope, E. D, "The Crocodilians, Lizards and Snakes of North America," Report U S National Museum, 1898.

[7] Strecker, J. K., "Reptiles and Amphibians of Texas," 1915.

A PROTEST AGAINST CRYPTIC TITLES AND INDIRECT LABELING OF FIGURES

IT is the usual thing to lodge complaints when established conventions are violated, but the writer wishes to point out that there are at least two conventions relating to form in scientific articles that could be violated with profit. This note sets forth a complaint against convention.

Many authors are prone to introduce their works to the scientific world in more or less uncertain terms. They handicap them with titles that are often cryptic in the extreme For example, what does "A New Insect from Utopia" mean? Any one who has had

experience in assembling a bibliography of a particular field will appreciate this sort of thing A title, especially of a supposedly scientific paper, should be concise. However, precision or conciseness in writing a title for a paper should not fall before undue brevity The writer certainly would not advocate a return to medievalism in such matters; but titles can be clear and at the same time brief With the title cited above as a horrible example compare "*Musca domestica*, a New Dipteran Insect from Utopia." A good title, then, should be as brief as possible and should convey a definite idea of the contents of the subjoined matter, and should always be used with general papers as well as with papers of a taxonomic nature.

Not very long ago a very excellent paper of considerable length and illustrated by well-drawn figures in a half-dozen or more plates came to me. This paper was a zoological thesis from one of the major universities of the country As it happened to be along a line of especial interest to the writer, it was read with care. But the ease of reading and the degree of pleasure and profit enjoyed were seriously marred by the fact that the figures on the various plates were labeled with abbreviations and that one had to turn to a distant page to find the key to these abbreviations. It would have been bad enough had the key been on the page facing the plate, or at the bottom of the plate itself Often, to make such a bad matter worse, the terms are not alphabetically arranged—they may even be omitted by error in some cases Needless to say, a study of such plates involves a great deal of time, patience, labor and even temper In many instances, unless such papers are of immediate interest, they go unread in so far as a careful examination of the plates is concerned

In the plates above mentioned, it was noticed that there would have been plenty of room to spell the labels out in full directly on the face of the plates, thus doing away with the necessity for a key, and at the same time effecting a saving of labor and space in production and a saving of time and labor in the ultimate consumption The artistic qualities of the drawings would not suffer in the least by such a procedure, on the other hand, accuracy and availability would be greatly enhanced

The present system of indirect labeling of plates is archaic and absolutely unscientific It should be changed to a system of direct labeling on the figures, together with any necessary explanatory matter (not a key) on the page *facing* the plate. Direct labeling can easily be carried out in all cases except possibly in those rare instances where the details are exceptionally small and numerous In such cases the key should face the plate and it should be arranged in an alphabetical fashion

It is to be hoped that those editors responsible for matter of form such as the above in scientific serials will effect changes looking toward improvement.

C. T HURST

DEPARTMENT OF ZOOLOGY,
MILLS COLLEGE, CALIFORNIA

QUOTATIONS

IN SCIENCE I note that attention is again called to the need of indicating in public addresses the beginning and the closing of a quotation. The terms "quote" and "unquote" are suggested by Mr Arnold.

Some years ago I knew a very intelligent young woman who used to inform us that her "bright sayings"—some of them—were not original, by raising both hands above her head with the first and second fingers pointing upward Her fingers were her "quotation marks" and were very easily understood. I have many times since thought that some such signs or signals would be useful for public speakers who wish to indicate when their quotation ends but do not care to say, "the quotation ends here" Probably both hands are not needed for the signal, but both for speaker and for audience some conventional sign would, it seems to me, be worth adopting

S FRANCIS HOWARD

NORWICH UNIVERSITY

THE METRIC SYSTEM

I READ with interest the letter of H J Page, of the Rothamsted Experiment Station, England, in SCIENCE for June 3, frankly confessing the great advantages of the Metric System over our stupid and inaccurate Anglo-American system of weights and measures, but explaining his use of the Anglo-American term of "quarter," &c, because his paper was intended for the agriculturists and not for scientists

I beg leave to commend to him the method adopted by the *Journal* of the American Medical Association by which one does not need the searching of dictionaries, etc.

In the text of this admirable *Journal* all weights, measures, etc, are given in the Metric System followed immediately in a parenthesis, by the Anglo-American equivalent This is gradually educating the public to the Metric System.

I hope and believe that the day of its adoption is drawing near.

W. W. KEEN

PHILADELPHIA, PA.

QUOTATIONS

A BRITISH COLONIAL RESEARCH

THE report of the Committee on Scientific and Research Services, which is published this morning,

marks an important step forward in the scientific use of British Colonial resources. The recommendations have been adopted by the Colonial Conference, and ideas which have been in the air for some time have now become definite proposals There is still, of course, a great deal to be done The committee have worked under great pressure, and a further committee will have to be set up to work out details The colonial governments have to give their consent and arrange their contributions to the central pool But the main principles that there should be a chain of research stations, like Trinidad and Amani, throughout the Empire, with a central directing council in London, controlling a mobile reserve of men of science, and that there should be an Imperial Scientific Service transcending colonial boundaries, have been accepted by the spokesmen of five-and-twenty colonial governments

The present plans are only for agricultural research. Medicine and forestry have been left to the recently constituted Medical Research Committee and to next year's Empire Forestry Conference But this report has the added interest that its underlying principles apply to all branches of scientific work It brings out three points that are very little appreciated—how small a sum the colonial governments spend at present on agricultural research as compared with other governments, how valuable the trade of the colonies is to Great Britain, and how closely the prosperity of that trade is dependent upon agricultural progress It is perhaps not surprising to hear that the United States already spends on agricultural research over $21,000,000 a year, and that the figure is growing. It is more surprising to learn that, though entomology is one of the most important and most highly organized branches of science in the colonies, their combined expenditure on it is little more than half the £100,000 a year that the government of Egypt spends. Henceforth it is proposed that the Imperial government and the colonial governments between them shall find £175,000 a year for agricultural research. That is considerably more than is being spent in uncoordinated ways to-day But the Empire Marketing Board has an appropriation for research, and the money found by the Imperial government is likely to prove an excellent investment for the taxpayers at home. The complementary character of the trade between Great Britain and the Crown colonies makes an increase in their purchasing power particularly advantageous to industry here. On the other hand the colonial governments stand to gain out of all proportion to their contributions, for, while these contributions will be based on their revenue, the services they will receive will be limited only by their needs and by the resources of the whole system They will be able to command first-rate men of science without having to find their salaries, because, if the conditions of service envisaged by the committee are created, the varied and well-rewarded career which the Colonial Agricultural Research Service will offer will enable it to attract the finest talent The advantage will be greatest to the poorest colonies, for there is no natural connection between a colony's financial strength and the urgency of its need for scientific help Moreover work well done in one colony is more often than not of value to other colonies, and the arrangements for more efficient intelligence service will make this more than ever obvious Thus both in the science of soils and in plant genetics—"where," says the committee, "no organization of any kind at present exists"—the gain of one colony is likely to prove the gain of all For this reason, if for no others, the proposals are plainly of interest to those Dominion governments who have similar questions of their own; and there is every reason for believing that what is now being set on foot for the Crown colonies will come in time to cover the whole Empire —*The London Times*

SCIENTIFIC BOOKS

A Bibliography of American Natural History. The Pioneer Century, 1769–1865 By MAX MEISEL Vol II Brooklyn, The Premier Publishing Company, xii + 741 pp

THIS, the second volume of Mr. Max Meisel's interesting and valuable contributions to the bibliography of the natural sciences in the United States, is in reality a history of the rise and development of the biological sciences in the first half of the last century in this country It includes also the earth sciences and the exploring expeditions which were often concerned with technical scientific matters as well as with geographical and military or naval affairs. The multiplication of organizations, such as scientific societies and academies, and of various enterprises, such as museums, botanical and zoological gardens, institutes, state surveys, and exploring expeditions, was remarkable in the various parts of the United States from 1800 to 1844. Whereas, from 1769 to 1800 only ten such enterprises were founded, in the period from 1800 to 1844 one hundred and twenty were started on their career Of these, sixteen were U S. Government Exploring Expeditions. State geological and natural history surveys followed with the rise of state consciousness. The first state geological survey was that established in North Carolina in 1823. Other states followed in rapid suc-

cession, South Carolina in 1824, Massachusetts in 1830, Tennessee in 1831, Maryland in 1833, Connecticut, New Jersey and Virginia in 1835, Georgia, Maine, New York and Pennsylvania in 1836, Delaware, Indiana, Michigan and Ohio in 1837, Rhode Island in 1838, New Hampshire, Iowa, Illinois and Wisconsin in 1839, and Vermont in 1844 Three botanical gardens were opened in the first decade of the last century. The major line of activity was, however, very largely the formation of local scientific societies, academies, institutes and museums These were the natural outgrowth of local enterprise and ambition and were obviously the most practical type in a period when travel was both expensive and time-consuming.

While there are these marked developments of state and local enterprises, there is at the same time a noticeable absence of federal activities, aside from exploring expeditions which usually utilized the federal army or navy personnel and guidance, and of national societies Two notable exceptions to this are the American Philosophical Society (1769) and the American Academy of Arts and Sciences (1780)

In the period from 1769 to 1844, and mainly after 1800, no less than 65 societies, lyceums, institutes, and the like, with state, county, city, or institutional designations in their names, were formed Many of these were short-lived, a few now continue to function abreast of the times, and a number of others seem to have acquired the status of ancient and honorable desuetude The close of this period saw the dawn of national solidarity in scientific matters with the formation of the Association of American Geologists and Naturalists (1840), out of which grew the American Association for the Advancement of Science and the National Institution for the Promotion of Science (1840), the predecessor of the Smithsonian Institution

Scientific journals and publishing enterprises also multiplied in this period Fourteen such serials, not professedly attached to institutions, were established between 1800 and 1844 Of these all but one, *The American Journal of Science*, have vanished, often after a brief career They lacked the environing conditions and institutional continuity to enable them to survive in the struggle for pabulum and patronage.

The bibliographer and librarian will find in this volume a valuable record of the fugitive publications of the early expeditions, the state surveys and the ephemeral societies and lyceums which sprang up throughout the Republic in its early days from Portland to Little Rock The investigator will find here accurate citations of all papers on subjects in natural history in practically all of the serials issued by the scientific agencies in the United States published prior to 1845. The historian of this scientific age will find here, in so far as names and titles can express it, an epitome of the pioneer days of American science.

CHARLES A. KOFOID

UNIVERSITY OF CALIFORNIA

SPECIAL ARTICLES

EFFECT OF SHORT ALTERNATING PERIODS OF LIGHT AND DARKNESS ON PLANT GROWTH

IN earlier papers dating from 1920, it has been shown that the relative length of the day and night may profoundly affect the course of development of plants With many species flowering and fruiting may be hastened or retarded by appropriate regulation of the daily period of illumination. In some plants flowering is favored by relatively short days, while in others reproductive activity is induced by long days Thus it was found that plants normally flowering during the fall or winter may be readily caused to flower in midsummer by excluding the early morning or late afternoon light for a few hours each day. When, however, these plants were darkened for a like number of hours during the middle of the day the vegetative period was not materially shortened. In this respect the plants behaved about the same as if they had remained in the light throughout the day. It appears that with the same total number of hours of daily illumination two shorter periods of light do not produce the same effect as a single uninterrupted light period. The view has been previously expressed that the length of day effect is not due simply to the total quantity of light energy received by the plant and additional evidence in support of this view is seen in the results of recent experiments having to do with the response of plants to variations in the distribution of a given number of hours of illumination through the 24-hour period Considerable work will be required to complete these studies but it seems desirable to report briefly at this time some of the results thus far obtained It has been previously shown that in June plantings of the Biloxi variety of soybeans the normal vegetative period at Washington is 80 to 90 days while exposure to a daylight period of 8 to 12 hours may induce flowering in 20 to 25 days Similar plantings were darkened daily from 10 a m to noon and from 2 to 4 p. m. As compared with the full length of day of summer this treatment not only failed to hasten flowering but actually delayed it by two weeks. On the other hand, when these and other plants of similar behavior were exposed to the full daylight period, but on alternate days only, the vegetative period was materially shortened, although not to the extent effected by a

short daily illumination period Experiments were next undertaken with uniform, relatively short alternating periods of light and darkness, using for the purpose small light-proof compartments, with 1,000-watt Mazda lamps as the light source Excess radiant heat energy from the lamps was prevented from reaching the plants by interposing a 2-inch screen of rapidly flowing clear water Light intensities of 2,000–4,000 foot candles at normal temperatures were thus provided Special timing devices were used for automatically turning the lights on and off at the proper intervals As a standard of comparison for the shorter intervals, 12 hours of illumination alternating with 12 hours of darkening was used and in some instances continuous illumination also was employed. In addition to Biloxi soybeans, the Mandarin which readily flowers in the long days of June (at Washington) and the Peking variety, normally flowering under a somewhat shorter day, were included in the tests With a 6-hour alternation of light and darkness the vegetative period of Mandarin was increased from 22 days (12-hour controls) to 34 days and the height was increased from 25 inches to 45 inches Neither the Peking nor the Biloxi showed flower buds at the end of 51 days although their respective heights were 42 and 40 inches. The 12-hour controls flowered in 23 and 43 days, respectively, and their heights were 29 and 51 inches In Rudbeckia bicolor, a plant in which flowering is favored by very long days, the vegetative period was reduced from 45 days to 37 days by the 6-hour alternation and the number of blossoms was considerably increased although the average size of the blossoms was reduced In these tests the mean daily temperature ranged from 69° to 72°, with extreme daily ranges seldom departing from the mean by more than 5 degrees and without important differences between the two compartments. With a 4-hour alternation of light and darkness Mandarin and Peking soybeans gave similar results. Experiments were then made with alternating light and darkness intervals of 1 hour, 1 minute, and 15 seconds, respectively. In several tests running from 36 to 53 days the Mandarin flowered after considerable delay under the 1-hour alternation, as measured by the vegetative period under the 12-hour interval, but failed to flower under the two shorter intervals. Biloxi soybeans failed to flower under any of the short alternations In contrast with the effect on soybeans, reproductive activity was materially hastened in Rudbeckia bicolor by the short alternations of light and darkness. Moreover, the vegetative period was about the same as under continuous illumination. In one test the vegetative period under the short alternations and under continuous light ranged from 31 to 37 days, as compared with 56 days under the 12-hour alternation The average height of the plants was 40 inches under continuous illumination and 20 inches under each of the light-darkness alternations. Summing up, it is apparent that with the plants in which flowering is favored by short days as well as with those in which the opposite is true, the general effect of the relatively short alternations of light and darkness on reproductive activity is much the same as that produced by long days or continuous illumination There is no suggestion of a short-day effect However, the short light-darkness alternations may bring about more or less serious nutritional disturbances and growth relations are markedly affected A striking feature of these tests with soybeans and Rudbeckia and with *Cosmos sulphureus* has been the chlorotic, weak, spindling type of growth produced by the short light-darkness alternations, which is especially marked under the 1-minute interval These effects seem to increase with decrease in the duration of the alternation until a climax is reached with the 1-minute interval Curiously enough, the type of growth is much improved again with the 15-second interval. Evidently, assimilation and other functions may be much disturbed under relatively short alternations of light and darkness. In this connection it is of interest to note that Warburg (Biochem. Zeitschr, v 100, 1919, p 230–270), working with Chlorella under very short illumination intervals, did not obtain the normal average rate of assimilation found for continuous illumination till the alternations were reduced to a length of about 004 second. Under the 1-minute interval in our tests with soybeans leaf development was poor, the leaves being reduced in size, chlorotic and showing large splotches of dead tissue The stems were slender and weak. Cosmos showed much the same characteristics in leaf and stem. Larger plants of Rudbeckia showed somewhat less leaf injury but small seedlings were unable to survive at all under the 1-minute interval. Taking 100 to represent the average dry weight of the aboveground parts of Rudbeckia under the 1-minute interval, in a typical case, the corresponding values for the 15-seconds, 1-hour and 12-hour intervals were 150, 175, and 250, respectively Similarly, with 100 as the dry weight of tops produced by Biloxi soybeans at the end of 21 days under the 1-minute interval, the corresponding values for the other intervals were 190, 280, 280, respectively, and 310 for continuous illumination. Similar, though somewhat larger, differences under the different exposures were obtained with Cosmos. Interesting contrasts in relative growth of root and top were shown by the soybeans and cosmos under the different light exposures. In the soybeans root development was very poor under the 1-minute and 15-seconds exposures, the

ratio of root to top being 1:7. On the other hand, the dry weight of roots produced by cosmos under these intervals greatly exceeded that of the tops, the proportion being 1..3–4. Under the other exposures the ratio of root to tops remained nearly constant and was about the same for both plants, namely, 1 3.0–4.0. The combined dry weight of root and tops of cosmos was the same for all alternations of light and darkness and slightly less than half of that produced under continuous illumination. With the soybeans this relation did not hold, the combined dry weight produced under continuous illumination being only slightly greater than that under the 12-hour and 1-hour alternations while the combined weight under the 1-minute alternations was relatively quite small. The effect on the growth and nutrition of the plant, at least in some particulars, suggests that commonly produced by weak light, although the leaf injury possibly could be considered as indicating excess illumination There seems to be no feature resembling the typical short-day effect except possibly that on root growth in cosmos These tests are being further elaborated and it will be of interest to study the effects of various other alternations with both equal and unequal durations of the light and darkness intervals.

W W GARNER
H A ALLARD

BUREAU OF PLANT INDUSTRY,
U S DEPARTMENT OF AGRICULTURE

IRON ORGANISMS

DURING the last two years we have endeavored to investigate iron organisms of the Gallionella group (Toxothrix, Spirophyllum, etc)

In the course of the work it became clear that a medium consisting of tap water ($pH = 7.6$) and iron filings was beneficial to their growth

The air carries, as spores or cysts, many iron organisms This was demonstrated by sucking outside air through sterile culture flasks Within five days cultures appeared, among which the curious Toxothrix, described by Molisch[1] from Japan, was conspicuous

The natural occurrence of iron organisms around Stanford University seems to be related to aeration of deep waters, either through cracks in a reservoir dam or from deep wells and springs In the former case aeration of the hydrotroilite black mud, containing large amounts of $(FeS)_x$ $(H_2O)_y$ causes a formation of H_2S, while the oxidation of ferrous iron goes parallel with a noticeable acidification of the aerated water (pH changes from 7.6 – 6.8).

The reactions involved are either

$$4FeCO_3 + 6H_2O + O_2 = 4Fe(OH)_3 + 4CO_2$$
$$4Fe(HCO_3)_2 + 2H_2O + O_2 = 4Fe(OH)_3 + 8CO_2$$

As soon as the pH drops below 7 the black suspended hydrated pyritite will begin to decompose.

It was at first thought that this fairly acid medium constituted the normal environment for the organisms This view seemed to derive support from the observation that Fe^{+++} becomes soluble at $pH < 5$ while Fe^{++} becomes soluble around $pH < 6.2$. This fact was checked with various organic and inorganic salts with fairly consistent results The availability of Fe^{++} for the alleged autotrophonts would be of course greater at a lower pH

However, cultures were very successful up to $pH = 9.2$ with an optimum activity around $pH = 8.6$ Here less than one part of Fe^{++} in 5×10^6 water was present, as checked by colorimetric determination Therefore, if the organism is able to use iron in its metabolism, it has to lower the pH locally so as to make it soluble.

A series of experiments was carried out in which the increase in weight of infected and sterile iron media (e.p iron filings, Cu-free, in tapwater) was established It appeared that no acceleration of the oxidation in the infected media could be observed in an eighteen-day run, although cultures developed normally Our microscopic findings check Cholodny's work[2] We observed, however, that the terminal organism may swarm, sometimes over a rather large area. It will settle down and begin to form a new stalk, which may be independent or become attached to the old stalk when the excreted mass increases. The terminal organisms are very small ($8 \times .5\,\mu$) Directly below the terminal cell the stalk is non-incrustated Incrustation starts in patches, hardly ever gradual

Both Molisch and Cholodny deny the presence of a core in the sheath and claim that the entire Gallionella is soluble in "dilute" acids Unfortunately, the H^+ concentration of their solutions is not mentioned in their papers.

It was soon found that by using various acids of a pH close to 5 (acetic, lactic, citric, butyric, tartaric) the sheath will dissolve, leaving a thin glistening core. We believe that Cholodny's comparison of the Gallionella group with certain flagellates (Anthophysa, Phalansterium, Spongomonas, Rhipidodendron) is a significant one

WILLIAM J. MEEHAN,
L. BAAS-BECKING

STANFORD UNIVERSITY,
CALIFORNIA

[1] Molisch, H, Rep Imp. Tohoku Univ Japan Series I 2, 1925.

[2] Cholodny, N., Die Eisenbakterien. Jena. Gustav Fischer, 1926.

THE IOWA ACADEMY OF SCIENCE

THE forty-first annual meeting of the Iowa Academy of Science was held with the State University of Iowa, at Iowa City on May 6 and 7, 1927, with 253 members and visitors in registered attendance

Special features of the general meeting were the president's address, "The Evolution of an Idea," by Dean C E. Seashore, in which he traced the idea that a specific trait can be measured quantitatively, "New Interpretations of Glacial Deposits in Iowa," by Dean George F Kay, dealing with the present status of the Iowan drift problem; "The Rise of Sap in Plants," by Professor A L Bakke, and the annual Friday evening lecture by Professor E C Stakman of the University of Minnesota on "Racial Specialization of Pathogenic Fungi"

The reports of the standing committees on conservation and publicity in high schools concerning research careers in science were especially timely and thorough

President D W Morehouse, of Drake University, was awarded a grant from the Academy Research Fund[1] of $200, or as much thereof as may be necessary, for the investigation of a nebula (dark) in Cygnus

The officers and section chairmen for the forthcoming year are as follows

Officers

President—L D Weld, Cedar Rapids
Vice-president—G F. Kay, Iowa City.
Secretary—P S. Helmick, Des Moines
Treasurer—A O Thomas, Iowa City
Editor—G. H Coleman, Iowa City
American Association for the Advancement of Science Representatives—D W. Morehouse, Des Moines; and C E Seashore, Iowa City

Section Chairmen

Bacteriology—C H. Werkman, Ames
Botany—R. A. French, Dubuque.
Chemistry—N. O. Taylor, Iowa City.
Geology—F A. Wilder, Grinnell.
Mathematics—Roscoe Woods, Iowa City
Physics—J A Eldridge, Iowa City.
Psychology—J. E. Evans, Ames.
Zoology—H W Norris, Grinnell.

The Academy convened in nine different sections for the presentation of 178 papers of special interest. Reports from these special sections, prepared by the retiring section chairmen, follow:

[1] This fund is made possible by the American Association for the Advancement of Science refund of 50 cents for each Iowa Academy-American Association for the Advancement of Science member.

BACTERIOLOGY

(By Jack J. Hinman, Jr., Iowa City)

The address of the retiring section chairman concerned the development of our present ideas for the measurement of the quality of water. The outstanding paper of the session was probably that by Dean R L Buchanan, of Ames, entitled, "Common errors in the application of physico-chemical concepts to the physiology of bacteria" Other important discussions were on the bacterial blackening of canned vegetables by C H Werkman and Helen J Weaver, the germicidal efficiency of alkaline washes used in cleaning beverage bottles by Max Levine, J. H. Buchanan, Grace Lease and E E Peterson, and on soil bacteriology by L W Erdman, R H Walker and Harry Humfield Medical phases of work were the subjects of papers by C S Linton who discussed the detection of trichina, and by H D Palmer who described two cases of mycotic infection which had come under his observation

BOTANY

(By G W Wilson, Fayette)

The program of the botanical section was varied and of exceptional interest. Castetter continued his reports on the germination of cucurbit pollen, Bakke compared inhibition in sweet and field corn, and the synthesis of amino acids in plants was presented by Loehwing Wylie continued his studies on cicatrization of leaves, and leaf fall in Populus was studied by Marts.

Ecological papers were presented by Pammel, Shimek and Miss Hayden, Miss Blagg gave a preliminary list of Mosses of Iowa, Prescott a similar list of Algae, and Martin presented studies on various fungi.

CHEMISTRY—INORGANIC AND PHYSICAL

(By Jacob Cornog, Iowa City)

The most novel research among the thirty reported at the Inorganic and Physical Chemistry Section was by Poulter and Frazer In this investigation they allowed zinc to come in contact with sulphuric acid under a pressure of 16,000 asmospheres and obtained hydrogen sulphide as one of the end products

ORGANIC CHEMISTRY

(By Henry Gilman, Ames)

G. H. Coleman and D. Craig obtained nitrogen, ammonium chloride, benzalacetophenone dichloride and a C-chloro-N-di-chloroamino ketone from the reaction between nitrogen trichloride with benzalace-

tophenone. G H Coleman and C R Houser obtained primary amines in yields up to 90 per cent. (with benzylmagnesium chloride) in the reaction between monochloramine and Grignard reagents L C Raiford and W C Stoesser prepared the 2- and 6-monobromo and 2, 5- and 5, 6-dibromo vanillins and investigated their chemical behavior. L C Raiford and G Thiessen reported on the effect of substituents in the formation and the reactions of certain ethers, particularly diphenyl ether H Gilman and J Robinson have prepared a number of organo-lead compounds that are being tested in connection with cancer, anti-knock compounds and in some plant diseases. H Gilman, J E Kirby, R E Fothergill and S A Harris reported on some abnormal reactions of organomagnesium halides, particularly benzyl-, cinnamyl- and related organomagesium halides, and the unique reactions of nitro compounds, like o-nitrobenzaldehyde, towards the Grignard reagent

GEOLOGY

(By A C Tester, Iowa City)

Eighteen papers were presented by thirteen different members of the Geology section Two new ideas, outstanding in their general interest, were suggested W H Norton presented evidence derived from a study of well cuttings which indicates that a gypsiferous, saline series of Silurian age underlies much of southern and western Iowa. Those beds occupy the same relative position as the Niagaran dolomites which outcrop in northeastern Iowa A. C Tester believes the late Comanchean seas covered western Iowa, for much fossil material of a friable nature has been found in the glacial drift and certain stratigraphic evidences warrant this conclusion

MATHEMATICS

(By J F. Reilly, Iowa City, Secretary)

The sixteenth regular meeting of the Iowa section of the Mathematical Association of America was held in conjunction with the annual meeting of the Iowa Academy of Science at Iowa City on May 6 and 7 The attendance was forty A program of nine papers was presented, and in addition two addresses, one by the retiring chairman, Professor J V McKelvey, Iowa State College, on "Discontinuities and Prerequisites," the other by Professor Dunham Jackson University of Minnesota, on "Trigonometric Interpolation" Professor Jackson was present by invitation Officers in addition to the section chairman were elected for the coming year as follows *Vice-chairman*, Professor E E. Moots, Cornell College, *secretary*, Professor J F Reilly, University of Iowa.

PHYSICS

(By M E. Graber, Sioux City)

The attendance at the Physics section was unusually large, and some 28 papers were presented, covering special fields of pure physics, and the pedagogy of the subject The physics section dinner was well attended, and immediately following this an interesting address on "The Applications of Ultra-Violet Light" was given by Professor J W Woodrow, of Ames The report of the Committee on Research was presented by Professor G W Stewart, of the University of Iowa

PSYCHOLOGY

(By C A Ruckmick, Iowa City)

The Psychology section was attended by about thirty-five psychologists of the state and by about an equal number of visitors outside of this group Seventeen papers were read centering on the following problems pitch perception in singing and speaking, pitch perception of beating intertones, the vocal mechanism, sound localization, description and objective record of emotions; visual "punning" in relation to *Gestalt*, visual perception of distance among young children, the optimal tempo in the rhythms of walking, running and skipping, muscular tonus of stutterers; psycho-physiological measurements of college athletes, a rating scale for the social behavior in young children, aptitude tests for college physics, the improvement of teaching psychology in elementary classes, and the study habits of college students There was considerable discussion of most of these papers

ZOOLOGY

(By L S Ross, Des Moines)

Twenty-eight papers, of which a few were read by title, were presented before the Zoology section Of these, twelve were on physiological subjects, anatomy and entomology had four titles each, ecology and protozoology three each; and ornithology and pathology one each One fact presented that was a surprise to the members is that bank swallows may have a variation of sixteen or eighteen degrees F in temperatures, the nestlings varying even to a greater extent. Another paper directed attention to an error that appears in certain laboratory manuals relative to the innervation of the ampullae of Lorenzini of the spiny dogfish. On the whole the meeting of the section was as interesting as any in recent years.

P. S. HELMICK,
Secretary.

SCIENCE

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PUBLIC HEALTH PROGRESS AND RACE PROGRESS—ARE THEY INCOMPATIBLE?[1]

THE public health workers, the social workers, the civilizers, we are told, are corrupting the race, are destroying the race. By protecting us from our enemies, the bacteria and the viruses, by removing the sources of disease, by showing us how to avoid unfavorable conditions and to find favorable ones, in short, by bringing us and our environment into harmony, they are promoting the survival of the unfit, they are progressively filling the race with the weak and the degenerate who must hand on their weakness and degeneracy to their descendants. This should all be stopped. In dealing with the delicate and ailing, our motto should be: Treat 'em rough!—Let the environment kill them. That's what will produce a strong race, a fit race.

To one who has spent his life studying the unnumbered devices by which organisms of all sorts protect themselves from their enemies, who sees that their daily, then hourly occupation is the seeking of favorable conditions and the avoiding of unfavorable ones—to such an observer this proposal comes as a paradoxical surprise. The public health worker, the social worker, is not alone in this nefarious business of adjusting the organism to the environment; everybody's doing it. And by everybody I mean our brothers, the birds and beasts, our cousins, the insects and worms and plants; I mean all organisms. We ourselves have been doing this sort of thing for a hundred million years. It's going to be a hard habit to break, if we must break it.

And as we look at it, the difficulties become greater. All organisms are *forced* to defend themselves in all sorts of ways against other organisms that seek to destroy them; against bears and beetles as well as against bacteria. All organisms *must* protect themselves against the injurious forces of nature, against heat and cold and wind and wet; against starvation and against over-eating; against unfit food and drink; against bumps and bruises and broken bones; against plagues and poisons. That's what life is: a struggle for existence. If any organism ceased this struggle, ceased to select its environment, ceased to protect itself—its kind would become extinct in a generation.

[1] Address at the twenty-third annual meeting of the National Tuberculosis Association at Indianapolis, May 24, 1927.

So it is with man, with bird, with fish, with worm, with protozoan, with plant

We can't therefore hew to the line in this matter, we can't stop this whole business of adjusting ourselves to our environment If there is anything at all in this proposal, it must be something very special Are there limitations that must be placed on this protective struggle? Are there certain methods of protection that organisms must not employ, methods that overshoot themselves and fall on the other side, methods that lead to degeneration and destruction instead of to the survival and prosperity that they are trying for? Are the methods of the public health worker of this sort? Or are there certain junctures in evolution when this protective work must stop, on pain of defeating its own aim? How shall we know those junctures? Has man reached one of them now? After unnumbered ages of striving for environmental adjustment must he now give that up?

Well, the point to all this—and it is beyond doubt a piercing point—comes to us from modern work in heredity, in genetics That has revealed to us that there are perverted methods of promoting survival and propagation, perverted methods of deciding who is to survive and multiply, who to perish without offspring—perverted methods that may and do result in a degenerate population Such a population has been produced by these methods The fruit flies of Morgan's laboratory are the pattern and exemplar of the kind of population that the pessimistic eugenicist predicts for man, a population composed of the congenitally defective, the halt, the blind, the weak, the variously deformed and degenerate Such things then can be done! We must sit up and take notice What is it that underlies such results? How can they be avoided?

Experimental biology has shown that what underlies them is this At its beginning the organism is a complex thing, containing a great number of separable substances—what we call the genes By the interaction of these thousand substances—with each other, with the cytoplasm, with materials brought in from outside, with the forces of the environment—development takes place, the individual is produced with all his later characteristics In early stages of development, the interactions of the genes produce new chemicals, enzymes, hormones, endocrine secretions, these again react with other products till there result, in a series of successive steps, all that we find in the body the sex hormones, the thyroid hormone, the hypophysial hormone, epinephrin, insulin, the digestive and other secretions, the blood, the tissues, the organs, the mature individual

But not all sets of genes are alike Different individuals start with different sets Some among the genes may be defective, sets containing these yield defective products Hormones may be produced that are deficient in quality or quantity, or both, this results in farther defects If the thyroid secretion is defective, either from poor genes or poor nutrition, the individual fails to develop normally, it becomes that pitiful half formed thing, a cretin, an idiot If insulin is not properly formed, diabetes results If the sex hormones are not normal, intersexuality or other discordant condition follows These are types of the results which follow from the operation of defective genes, or from defective interaction of the genes

But chemical therapeutics discovers that disorders due to defective genes can be remedied if we know the means, just as other chemical processes may be influenced The consequences of a defective thyroid secretion are remedied by introducing the thyroid hormone with the food, the pitiful cretin becomes a normal human being Lack of insulin is similarly remedied, by introduction of insulin from outside The necessary chemicals can even be synthesized, made artificially, as recent revolutionary researches show The genes are not something mystical, unapproachable, they are organic chemicals In principle, it is clear that defects in the store of chemicals given us by heredity may be supplied by other means, that undesirable things in the store of genes may be cancelled or corrected, that reactions among them which take an undesirable turn may be altered, set right All these things are seen to be mere matters of technique, one needs but to know how The great advances already made in this direction have come in the last 10 years How far will they have gone in 100 years? In 1,000 years?

Wonderful possibilities are opened up by this work Unfortunate human beings that must have suffered in misery, a burden to themselves and others, are made normal, useful, happy

But consider now the farther results of an enormous future development of synthetic chemistry, of chemical therapeutics. Defects in genes become as open to remedy as defects in nutrition A defective thyroid product is replaced by manufactured thyroxin, the individual is restored to normality But his genes are not changed, they remain defective; they are transmitted to his descendants His descendants too must be treated with thyroxin The genes of another individual are defective for the secretions of the hypophysis, of another for the suprarenal secretion; of another for the reproductive hormone, of another for insulin Chemotherapy remedies all these defects—for these individuals But their descendants, receiving the defective genes, must likewise come under the treatment of the chemist. In time the race thus accumulates a great stock of these defective genes. Every

individual that receives them must be treated with one or more of the substitutes for the normal products of the genes Each must carry with him an arsenal of hypodermic syringes, of vials, of capsules, of tablets Each must remain within the radius of transportation of the synthetic chemical laboratory on which he depends *This* is the result of remedying gene defects

This picture is not an attractive one Far better is the later condition of the race in which, through lack of skill in synthetic chemistry, defective genes have been cancelled as they arise, so that each individual bears within himself, in his stock of genes, an automatic factory for the necessary chemicals That must be our aim, our slogan for future generations must be Every man his own hormone factory!

How is that end to be attained? Is there no recourse but to strike at synthetic chemistry? Must the unhappy chemist be proscribed, prosecuted, imprisoned, hanged, his books burned, his teaching forbidden, his methods of work prohibited? Must the cretin drag out his life a helpless idiot, the diabetic suffer unrelieved—till their own defects close their lives in misery, and so cancel their stock of genes? Are these the methods that must characterize our policy toward defects in the genes?

It certainly behooves us as rational beings to examine such a situation with care, to search whether there be not peradventure another way of meeting it And when we do this, we find these proposed measures to be totally and preposterously unnecessary, uncalled for, absurd, nay more, ineffectual There is another recourse, a simpler one, a more effective one, an infinitely preferable one

The mere survival of a genetically defective individual—nay, his enjoyment of a full, a useful, a happy, a long life—does nothing to increase the degeneracy of later generations—provided he does not propagate Not survival alone, but also propagation, is required for the perpetuation of defective genes Without propagation, survival is harmless, so far as racial deterioration is concerned. Can there be any question as to which shall be the point of attack? Surely we write ourselves down as asses, as doubly and triply stupid, irrational, perverse, if in order to prevent the perpetuation and multiplication of certain genes, we can think of no method better than to stop scientific investigation, to stop humane practices, to force our fellow beings to live and die in misery that we know how to prevent The lives of persons bearing defective genes may be made as satisfactory, as complete, as the most advanced methods can make them, without the smallest harm to the race—but they must not propagate.

Not the wasting away and death of the bearer of defective genes, therefore, but the prevention of his propagation, is our remedy The method of allowing the individual's own defects to destroy him is not only hideously repulsive to our instincts, but a knowledge of genetics shows it to be ineffectual, it does not get rid of the defective genes Most gene defects are recessive, they are therefore carried by ten times as many healthy individuals, not showing the defects, as by individuals in which the defects are manifest The children of such healthy individuals receive defective genes, as do children of defective individuals Congenital feeble-mindedness due to a single gene defect presents perhaps the most pronounced and the very simplest case of gene defect that has to be met Yet East[2] and Punnett[3] have shown that to merely cancel the deficient individuals themselves—those actually feeble-minded—makes almost no progress toward getting rid of feeble-mindedness for later generations As East pointed out, any really effective action in this direction requires that we learn in some way to distinguish the tenfold larger number of normal individuals that bear the defective genes, and that we prevent *their* propagation To merely cut out the defective individuals themselves, particularly to do that only weakly, haltingly, ineffectually (allowing them time perhaps to propagate before death overtakes them)—as would result from withdrawal of public health measures- *that* will not touch the root of the trouble

The *only* remedy is to stop the propagation of the bearers of defective genes The public health worker must take this fact seriously, a burden of responsibility is placed on him, he *must* become genetically minded, eugenically minded If he promotes, in the congenitally defective, propagation as well as survival, his work does indeed tend toward a measure of racial degeneration But it is the propagation, not the survival, that is the central point So fast as we can discover individuals that bear seriously defective genes—whether themselves personally defective or not—so rapidly must those individuals be brought to cease propagation

There are great difficulties, of course The instincts connected with propagation are strong But those instincts are readily circumvented They can be satisfied without the production of offspring. Thousands of individuals in every generation voluntarily relinquish the leaving of descendants Far different is the case with any method that strikes at life itself, once that is in action To life humanity clings with every trembling fiber of its being. The difficulties of ending

[2] "Hidden Feeble mindedness," E. M. East, *Journal of Heredity*, *8*, 1917, pp 215–217

[3] "Eliminating Feeble mindedness," R C Punnett, *Journal of Heredity*, *8*, 1917, pp 464–465

the careers of defective genes by preventing propagation of their bearers are as nothing compared with the hopeless proposal to allow defective individuals to waste away and die unaided. Can any one suppose that a race of beings so perversely stupid as to refuse to stop even the propagation of defective individuals can be persuaded to adopt the barborous, needless and ineffectual plan of killing them by the slow, the cruel method of refusing them available help in their distress?

Technically, a greater difficulty lies in the fact that the immense majority of defective genes are stored in normal individuals, and that recognition of these storehouses is not yet possible. Before that can be done, genetics must advance far beyond its present point. For no scientific advance is there greater need. Until that comes, genetics can propose no practicable plan for positive race improvement. But any single case saved from propagation is a gain. A defective gene—such a thing as produces diabetes, cretinism, feeble-mindedness—is a frightful thing; it is the embodiment, the material realization of a demon of evil; a living self-perpetuating creature, invisible, impalpable, that blasts the human being in bud or in leaf. Such a thing must be stopped wherever it is recognized. The prevention of propagation of even one congenitally defective individual puts a period to at least one line of operation of this demon. To fail to do at least so much would be a crime.

But how far is there reason to hold that public health work is indeed preserving individuals with defective genes? There can be little doubt, from the general picture presented by genetic investigation, that diversities in the genes, in the original constitution, of different individuals, affect every characteristic, of whatever sort, without exception. There can be little doubt that other things being equal, some genetic constitutions are more readily attacked by plague, by smallpox, by typhoid, by pneumonia, by tuberculosis, than are others. Certain constitutions yield more readily to extremes of temperature, to exposure to the elements, to unfit food. Certain combinations of genes are more likely to come off victorious in a struggle with a wildcat, or to survive a bite from a rattlesnake. Under such emergencies, those genetic combinations which survive are obviously more desirable. And removing any of these sources of danger—cutting off plague or pneumonia or wildcats or rattlesnakes, or subjection to cold—does permit combinations of genes to survive and propagate that otherwise could not do so. Any radical change in the environment alters the incidence of selective elimination, consequently alters the characteristics of the population in later generations.

But for all such cases the essential question is this: If the environmental agent—whether disease, weather or wild beast—can be controlled, prevented from attacking man—are the individuals thereby saved still undesirable—unfit, in other respects, to be citizens of the world? Are their genes radically defective, inevitably yielding deficient men and women, even though protected from environmental conditions that they are unable to resist? Or are they merely particular combinations that are fitted to one environment rather than another? No combination of genes yields human beings that flourish equally well in all environments. The victims of smallpox, yellow fever, hook-worm, malaria, of sunstroke, frost-bite, lions—must we believe that they are individuals with such serious genetic defects as will make them or their descendants obnoxious, degenerate, members of the community—even when those plagues have been banished by hygiene and invention?

Of course this is, for every separate case, a question of fact, to be determined by investigation. In some cases, as we have seen, it is now clear that the individuals saved *do* bear deficient genes; these are the cases for which the remedy is cessation of propagation. In certain other of the plagues of humanity the question is still open; such perhaps are tuberculosis and cancer. In certain strains of animals, marked susceptibility to cancer is due to a single gene defect; if such strains are to be found in man, their members should not propagate. But we must not fall into the fallacy that was characteristic of the beginnings of knowledge in genetics—the fallacy of holding that because in some cases cancer is dependent upon a serious gene defect—therefore it must be so dependent in all cases. Cancer may be induced in strains that are seemingly quite normal—though less readily induced than in those with defective genes.

The case of tuberculosis illustrates the complexity of the biological situation met in dealing with most of the plagues of mankind. This is not my field of work and I can not speak authoritatively on the details, but to try to state the apparent situation from a general biological point of view may be of interest, and provide a basis for discussion.[4]

It is clear that environmental conditions play a very large part in the incidence of tuberculosis. The rôle of the tubercle bacillus is beyond question; yet its presence is so nearly universal that it plays a relatively small part in deciding who shall, who shall

[4] Discussions of this matter that are based upon sound and adequate biological foundations are given by Lenz, in Baur, Fischer and Lenz's "Menschliche Erblichkeitslehre," sec. ed., pp. 254–258, and by J. Bauer, in his "Konstitutionelle Disposition zu inneren Krankheiten," 1917, pp. 52–59. It is much to be desired that these works should become available in English translation.

not, succumb to the disease There is positive evidence[5] that closeness of association with active cases of the disease tend to make the individual succumb, in other words, frequent infection with large numbers of the organism more readily produces active disease Again, under-nutrition, exposure, any conditions that markedly lower the vitality, tend to increase the number of cases of the disease All these may be classed as environmental conditions On the other hand, there is strong evidence that hereditary, that genetic factors—many diverse genetic factors—play important rôles in determining who shall be affected with tuberculosis Certain races are more prone to tuberculosis than others Within a given race, it seems clear that individuals bearing certain genes, or certain combinations of genes, are more susceptible to tuberculosis than are those with others But there is no single gene, no single combination of genes, to which alone can be attributed the greater susceptibility to tuberculosis Various genetic types show higher susceptibility, those that yield the asthenic constitution, those that yield what is called infantilism Any gene or combination of genes that seriously interferes with proper nutrition lays the organism open to attack of the tubercle bacillus, thus diabetics (whatever the cause of that disease) are prone to tuberculosis A great number of diverse genes are involved in such effects, and these genes are beyond doubt mainly recessive We do not, therefore, get rid of them by the destruction of tuberculous individuals, much the greater proportion of them is present in normal persons Here as elsewhere in the operation of inheritance, individuals that are themselves healthy may, and often do, produce offspring that are genetically defective, individuals that are themselves defective, and for genetic causes, may and do produce normal offspring

Further, genes that tend to give high susceptibility to attack of the tubercle bacillus may coexist with genes that give high vitality and efficiency in other respects, this Wright[6] demonstrated in his experimental work with guinea pigs. A parallel situation exists in mankind with respect to tuberculosis and intellectual qualities, the De Morgans, the Robert Louis Stevensons, can not be considered inferior types, in other respects than their proneness to tuberculosis

Such then is the biological situation, a great complex of variable factors of many kinds, each having its influence on the incidence of tuberculosis To attempt to meet such a situation, to attempt to get rid of tuberculosis—merely by allowing the ravages of the disease to remain unchecked, appears unintelligent, feeble, hopeless It is possible that a time may come when certain well-defined particular genes shall have been identified as strongly predisposing to tuberculosis, and when the carriers of those genes can be identified. When that time comes, if it ever does, the individuals bearing such genes, whether themselves tuberculous or not, should cease to propagate Only in this manner can the genetic factors be effectively attacked And in the meantime, the war on the environmental factors must continue It seems probable that the genetic factors can never be practically dealt with until the environmental factors are largely controlled, this is the teaching of most practical work in genetics

A similar situation would be met in an examination of other plagues combatted by public health measures But for many of the matters with which the public health worker deals, there appears to be no indication whatever that the individuals preserved are undesirable, or at a disadvantage, in a world in which the attacking agent has been controlled, no indication that defective genes are playing an important rôle. There is not ground in man for holding that all differences in genes imply defectiveness in one or the other We can not in man (as perhaps we can in the fruit fly) set up for each particular gene one type as the only normal one, compared to which all others are defective There are many types for each gene, some adapted to one method of life, some to another. There are millions of diverse combinations of these different types, some flourishing better under one set of conditions, others under another set of conditions, none of them requiring to be considered pathological

Our question here merges into a general biological one. Can it be maintained that *any* protective or defensive action, *any* selective control of the environment, is harmful to the race, as leading to degeneration, through the cessation of selective elimination?

Various dangers have been suggested Increased propagation resulting from environmental control of disease may result in a greater population than the environment can comfortably support Here the remedy, if one is required, is again obviously to slow down the rate of reproduction, as most civilized communities are doing

Again full success in protection by one method makes it unnecessary to develop other methods The oyster, protected by his thick shell, has not developed ingenuity, inventiveness, intellectual power Coming in contact with another organism that has, it may go to the wall, as the oyster shows signs of becoming extinct in contact with man. This somewhat specu-

[5] See Pearl "Constitution and Tuberculosis," in "Studies in Human Biology" (1924), pp 273–297.

[6] "Factors in the Resistance of Guinea Pigs to Tuberculosis, with Special Reference to Inbreeding and Heredity" *American Naturalist*, 1921, vol. 55, pp. 20–50.

lative difficulty suggests no practical measures for our own case

More palpable is the following: Complete success in any one method of defense against a particular enemy makes other methods unnecessary, the organism is no longer selected with reference to those other methods, and may lose them Completely destroy certain pathogenic bacteria, or develop external methods of protection against them, in consequence the internal protective action of the body fluids is no longer necessary, it might in the course of generations be lost If by clothing, houses, fire, we keep our bodies at the optimum temperature, we may or might lose in later generations the power of resisting high and low temperatures

The extent of the occurrence of this sort of action is rather speculative But assuming that it occurs, the result in first instance is merely that the organism no longer retains the power of resisting an enemy that does not attack it, a harmless change

If, however, by a later change in conditions, as by a sudden overwhelming alteration in climate or an increase in the virulence of a bacterium, the methods of protection hitherto employed become ineffectual, then the organism might be driven back on its second defense, its internal power of resistance to infection, or to cold If this has been lost, the organism might become extinct Speculative ingenuity may suggest that this has been a cause of the extinction of some organisms that have disappeared

But in view of the fact that control of the environment is the very fabric of life, that organisms can not live without it, that they have been practicing it assiduously for uncounted ages, and that some of them are still flourishing, it appears idle to suggest that such control must be abandoned, it appears whimsical to look for imminent degeneration or extinction through that method of action If such were its necessary consequence, organisms must have disappeared long ago, nay, they never would have appeared Any organism *must* admit to itself, draw to itself, seek out, those conditions that are favorable to its physiological processes, this is the daily business of life The practice of hygiene, of public health is but one farther link in a chain that goes back to the beginning of life Amoeba covers itself with a semi-permeable membrane, admitting some chemicals, excluding others Protective coverings become in other animals more and more efficient—the skin, hair, feathers, the heavy shell of the oyster, the armor plates of dinosaur and armadillo Microscopic enemies that penetrate these defences find the body fluids charged with destruction Elaborate internal mechanisms are developed for keeping the temperature high and uniform Strength of body, quickness, agility, the development of claws and teeth—these seize advantage by transforming the defensive into an offensive Acuteness of senses, cunning, inventiveness, supplement all these methods, supply the lacks in any of them Cooperative action registers an enormous advance Shelters, clothes, are found or devised, fire taken into service, food cultivated, weapons invented, machines produced, the properties of substances tested, new ones compounded Devices come into existence for recording the results of tests once made, for preserving knowledge as it is gained Some organisms proceed to that systematic elaboration of methods for discovery and application of knowledge that we call scientific research, the most powerful aid yet devised for bringing the environment under control If environmental control is harmful, the first thing to do is to stop scientific research, only so can we strike at the root of the evil Hygiene, medicine, the arts of public health—these are not something new in kind, these are but later terms in the long series that begins where Amoeba takes in certain substances and rejects others With the other practical arts, they result in adapting the organism more and more completely to the environment Along this road we must indeed watch for the sporadic appearance of defective genes, and these we must cancel by the only possible method—by stopping the propagation of their bearers But defective genes are not the characteristic result of this process, degeneration and extinction are not its normal consequence Abandonment of environmental control, cessation of the process of adjusting ourselves to the conditions—this is unnecessary, undesirable, impossible, unthinkable The proposal for such abandonment is merely a characteristc instance of that modernism or "modernistic-ism" so rife in art and literature, that insists at any cost of sense or plausibility in saying something that has not before been said; doubtless in the hope that by trying all propositions, some time one that is worth while will be hit. The proposal to abandon control of the environment is not a serious contribution to the practice of life

H S. JENNINGS

THE JOHNS HOPKINS UNIVERSITY

DR. FRANKLIN P. MALL[1]

I FIRST knew Mall in 1884 (or '86?) when I was an assistant to Professor Welch in the pathological laboratory of the Johns Hopkins University. The laboratory was a small building which stood on the grounds

[1] Contributed to a collection of material relating to the life and work of Dr Mall, gathered by L B Schmidt, of the Iowa State College of Agriculture and Mechanic Arts.

of the hospital, which was then in process of construction Mall had just returned from Germany where he had worked in the laboratories of Ludwig and His and brought with him the methods and ideals of these remarkable men He had made a strong impression upon both and retained their interest and friendship as long as they lived

With the establishment of the university a system of fellowships had been created, but at the time, save in the department of physiology in the university, there were in the country no fellowships or any other positions in medicine which offered a modest support to one engaged in medical research All the teaching positions in medical schools throughout the country, with the exception of the chair of physiology at Harvard, were held by men who were active practitioners of medicine as well, and the professorial positions were regarded as valuable adjuncts to a medical practice A fellowship in pathology was established by the university, and Mall was the first incumbent It seems remarkable when one looks back upon the men who held these early fellowships at the Johns Hopkins, so many of whom have become distinguished, that opportunity for work and workers should have so coincided

Mall quickly interested all the men who were associated with him and gave them an impression of his character, which constantly deepened and which can never be effaced from their memories The impression was all the stronger because its production was not consciously sought I think that our first idea of Mall was that he was unusual, very modest, even shy in manner, perfectly frank and simple He lived a life of study, and work in the laboratory had little contact with the world outside and little knowledge of it He had brought a reputation with him and had won the respect and friendship of two of the leading men of science in Europe—not a small accomplishment. Life in the laboratory was extremely simple We were all young and healthy, there was an atmosphere of work, a happy even joyous, carefree existence and close friendships I am sure we all thought ourselves much more sophisticated than Mall, but sometimes in our talk he, usually so quiet, would suddenly flash out with an idea, which, when one came to think it over, seemed the wisdom of the ages He was helpful in criticism and suggestion and in these always modest and tactful

He had a way of looking at things in his work which was strange to us He sought to know the details of structure, not merely the cells and the tissues, but the relations of these in the three dimensions of space. Although skilled in the methods of what was called histological research, involving the cutting and staining of thin sections of tissues for microscopic examination, he added other methods by which parts of organs were digested away and the tissues so separated that their relations could be studied. At that time I had never heard Mall refer to Bichat, and yet both the men and the methods they used were very much alike Mall at that time must have been of about the same age as was Bichat, when the latter was writing his famous "General Anatomy" Bichat endeavored to show the nature of the different tissues which composed organs and the interrelationship of these in structure To do this he separated the tissues of organs by boiling, maceration and other physical means Mall with more refined methods carried the same sort of study into the finest details of structure, he subdivided the elementary tissues into those with the same physical and chemical characteristics and studied their relationship in anatomical structure He was skilled in the technique of injection of the blood vessels, and the course, arrangement and distribution of these in organs claimed special attention His conception of an organ involved everything pertaining to it, including embryonic development and function There was never haste in the publication of his researches His work was so new and original that there was never a question of priority, and so generous was his nature that he would have welcomed and assisted a rival His great work on the connective tissues was published some years after its completion, and the same was true of his studies of the intestinal canal When he did publish his work, it was so complete, so well illustrated, so accurate in description, that it seemed to be final I am particularly fond of recalling in this connection his work on the structure of the liver Notwithstanding the great amount previously written on the embryology and histology of this organ, it was only after reading the work of Mall that I arrived at an understanding of the liver His description was based on the lobule, its development, its growth and the relation of size to the length of capillaries The law which he established and which governs the embryological development has been shown to govern also the growth which occurs under pathological conditions In the minute subdivision of detail he never lost sight of the whole He had the rare power of visualizing in the three dimensions of space and of projecting this visualization into the mind of the reader In the great amount of the work which came from his students and which has been the main influence in giving anatomy in this country the high position it occupies, the principles involved in his early work have been followed

He was the greatest teacher of anatomy of his time. Had he been shut up in a cloister, he would have been a teacher, for the investigator has that

quality, without which all teaching is futile, of stimulating the desire of knowing At the time of his appointment as professor of anatomy, anatomical teaching in this country was on a low plane. With few exceptions the professors of anatomy in the medical schools were practitioners of medicine, usually surgeons, and the anatomical course consisted of formal lectures and demonstrations, so subdivided in the large audience by distance that in demonstrations each student received a very imperfect idea of the objects shown thirty to sixty feet away The lectures were the main discipline and were supplemented by text-book recitations and by a limited course of dissections Rarely did the student receive the stimulation to endeavor to find out things by the exercise of his own powers, nor did the discipline involve training in those powers of observation and judgment by which knowledge is obtained The attempt was made to have the student acquire what was quaintly termed the mastery of a subject by being told or by reading descriptions of what others had seen The method is one that has by no means been given up and may be said to be the current method of instruction in most subjects in the schools to-day Mall's departure from this method was radical He held the view that the essential in teaching should be directed to the development of the power of the individual, and that knowledge comes not from being projected into the student from without, but must grow from within on the material obtained by the skilled use of the senses directed on the object studied The primary knowledge of the thing so acquired could be expanded and coordinated by lectures, demonstrations and by reading. This is the natural method pursued by children before the unnatural methods of school are substituted and the intellectual curiosity which stimulates the child to seek knowledge is killed Mall introduced the utmost freedom of study and of teaching into the laboratory Students have told me that they felt lost when they went into the laboratory and before they understood the spirit of the place They were so unaccustomed to a lack of direction of their intellects With all the freedom of study that prevailed the students were well cared for and the progress of each man followed. The teacher was always at hand to assist, often to guide and always to encourage and stimulate The result is seen in the position of anatomy in this country to-day There is no teacher, no student of the subject who has not directly or indirectly, consciously or unconsciously profited by the methods, the work and the ideals of this great teacher.

The best men were attracted to him, and his work has been multiplied a thousandfold by his disciples This method of teaching is one which, though universally applicable, produces the greatest result in the hands of such a born leader as was Mall, a man who was able to say to his students, "*Come* with me along this road" There is a great difference between "come" and "go" His laboratory was a model of good housekeeping, always orderly, and he was a good provider of facilities for work The anatomical material was abundant and well preserved, and dissection was robbed of many of the unpleasant features usually connected with it There was an abundant store of carefully made dissections, as available for study as the books in a library

It is interesting to attempt to form an estimate of a man by comparing him with others, extremely difficult, for men and environmental conditions are so unlike There is such a difficulty in comparing the work of Mall with that of his colleagues, many of them men of the highest type, all differing, each in a different way exerting a great influence. It is enough to say that Mall stood in the first rank of these men

As a last word I must speak of the great honesty of Mall which appeared in every relation, and with his honesty his perfect fearlessness He was not a compromiser, and where his ideals of right showed him the way he fearlessly followed, no matter how difficult the road The world has sustained a loss in his death, a place is vacant which probably will not be filled, at least not by the same type. His friends whose esteem and affection he won will like to think about him and recall in their minds the old associations, none of these giving pain To his family he has left a great name, and his descendants may well be proud of their ancestor

W T COUNCILMAN

HARVARD MEDICAL SCHOOL

SCIENTIFIC EVENTS

EXPEDITION OF THE AMERICAN GEOGRAPHICAL SOCIETY TO CENTRAL PERU

AN expedition from the American Geographical Society of New York will leave this week for Central Peru to explore and map the sources of the Maranón River, the principal tributary of the Amazon, and a large section of the vast forested region which lies along the eastern border of the Andes between the upper Maranón and the Ucayali River. In addition to an extensive program of topographic and reconnaissance mapping, studies will be made of the geology, meteorology and plant and animal life of the region.

To the scientific explorer as well as to the explorer for exploration's sake, the region which the expedition

will study is one of the most alluring of the many little-known areas of South America. Here on a vast plateau nearly 15,000 feet above the sea, within a hundred miles in an airline from the Pacific coast but separated from it by the lofty, snow-capped wall of the main range of the Andes, and within thirty miles of each other are the sources of three great tributaries of the Amazon—the Maranón, the Huallaga and the Mantaro.

It is a curious fact that, with all the explorations that have been made in the Amazon Basin in the past hundred years, the actual sources of the main tributary of the world's greatest river have never been carefully explored and from the standpoint of accurate mapping are practically unknown. The headwaters of the Maranón consist of a chain of glacier-fed lakes some thirty miles in length which lie close against the eastern edge of the cordillera of the Andes about fifty miles northwest of the famous American-owned copper mines at Cerro de Pasco. Although it it believed by many that in the towering crests of the Andes from whose melting snow-fields and glaciers this chain of lakes is fed, peaks will be found that will rival the highest altitudes so far determined in Peru, none of them have been accurately measured.

Of the lakes themselves little information is available. In 1909 Sievers, the German geographer, visited and described a group of small lakes which form the uppermost part of the chain. The survey made by the Intercontinental Railway Commission in the early nineties crossed the lowermost of them at the point where it empties into the Maranón. Between these two points there are only vague and conflicting descriptions by a few native travellers. A topographic survey of about 350 square miles will be made between the crest of the Andes and the secondary range which bounds the lake region on the east. This survey will be tied in to a base established at Cerro de Pasco and accurately located by astronomical observations. It is believed that the geological studies in this section will be especially interesting. North and south of the region the Andes are known to be highly mineralized. At Mina Ragra a short distance south of the point where the survey will begin are located the mines of the American Vanadium Corporation, from which comes the major portion of the world supply of vanadium.

From the lake region a reconnaissance traverse checked by frequent astronomical observations will be carried for about a hundred miles northward along the upper Maranón, thence eastward through the densely-forested montana to the Huallaga and Pachitea Rivers, and back to Cerro de Pasco. This part of the work will include about 400 miles of reconnaissance surveys. Topographic surveys will be made of small areas at critical points along the route, meteorological records will be kept and observations on the plant and animal life recorded as a basis for distributional maps now in process of construction by the American Geographical Society.

The cartographic work of the expedition will be of great interest to geographers and kindred scientists because it will fill with accurate surveys one of the largest blanks which still exists in the map of South America. In general, maps of Hispanic America are highly inaccurate and scientists have been, for that reason, greatly hampered in their work all over this great realm. For the past six years the American Geographical Society has had a large staff of expert cartographers engaged in assembling material for a great map of Hispanic America. This map is on the scale of 1:1,000,000 and conforms to the standards of the International Map of the World. It is being compiled from original surveys and will represent, when completed, the total present knowledge of the cartography of Hispanic America. The Hispanic American governments as well as American and European explorers and development companies have shown enthusiastic interest in the task of assembling material for the map. The society's collection now numbers thousands of original surveys. There still remain many gaps, however, in areas in which no surveys have been made. The region selected for the present expedition is one of the most critical of these areas. The society hopes by future expeditions to be able to fill many other important blanks on the map.

From the standpoint of the surveyor the expedition will be highly important in that it will afford an opportunity to test out in the field the methods of rapid mapping which the society has been developing during the past seven years. The expedition will be equipped with a set of instruments which represent a maximum of accuracy and speed of work with a minimum of bulk and weight. They include the new Weld theodolite, the Barr and Stroud range finder, and an extremely small and light wireless receiving set for obtaining time signals for longitude.

The expedition, which is in charge of O. M. Miller, of the society's School of Surveying, will leave New York on June 23 on the steamer *Santa Teresa* of the Grace Line. Kaspar Hodgson, son of C. W. Hodgson, of Yonkers, will be a member of the party. The party will also include, beside assistants, a geologist who will study the mineral resources of the region.

HONORARY DEGREES CONFERRED BY YALE UNIVERSITY

HONORARY degrees were conferred by Yale University on the occasion of the two hundred and twenty-

sixth commencement exercises on June 22, when Professor William Lyon Phelps, public orator, presented the candidates and President James Rowland Angell conferred the degrees Those conferred on scientific men are as follows:

Charles Value Chapin

Professor Phelps A graduate of Brown and of the Bellevue Medical College in New York, Dr Chapin has a magnificent record as a promoter of health and foe of disease He has been health officer of the city of Providence since 1884 and city registrar since 1889. He is the leading figure in the development and standardization of public health practice in the United States. To him we owe the formulation of the entire modern viewpoint in the control of communicable disease. His book on "Sources and Modes of Infection" (1910) is highly important. In 1906 the American Medical Association had voted that Dr. Chapin's method would do "infinite harm", to day the whole world follows his lead Dr. Chapin has no talent for publicity, but those who are familiar with the history of the movement for public health look back, and at, and up to him.

President Angell: To have been instrumental in materially improving the health and happiness of untold millions is a noble achievement This fact Yale would publicly recognize by conferring upon you the degree of doctor of laws and admitting you to all its rights and privileges

John Jacob Abel

Professor Phelps Dr. Abel was this year awarded the Willard Gibbs Medal, for having done more than any other living scientist, without pecuniary advantage to himself, "to promote enjoyment of life" He is a graduate of the University of Michigan and of Johns Hopkins For seven years he studied at various European universities, since 1893 has held the chair of pharmacology at Johns Hopkins and in 1920 received the degree of doctor of laws from Cambridge He is the foremost pharmacologist in the United States. He has in large measure determined the trend and character of this science in America Some twenty years ago he discovered epinephrine, the active principle of the supra renal gland. Then he rested and in 1910 got his second wind His recent activities and discoveries have been remarkable, all the more so because he has been a lone worker His discovery of amino acids in the circulating blood was the foundation for our modern conception of protein metabolism His investigation of the active principle of the pituitary gland promises to yield significant results In 1926 he announced the preparation of a pure crystalline insulin, which is going to be of the highest importance in the cure of diabetes He is truly a great discoverer and a great benefactor, though he is too busy to know it

President Angell It is a peculiar pleasure to me, who have known you from boyhood, to be the agent through whom, in recognition of your extraordinary contribution to the understanding of the conditions of health and of disease and thus to the relief of human suffering, Yale herewith confers upon you the degree of doctor of science, admitting you to all its rights and privileges

Alfred North Whitehead

Professor Phelps Mathematician and philosopher Born in England, a graduate of Trinity College, Cambridge, and later fellow and senior mathematical lecturer, since 1924 he has been professor of philosophy at Harvard In 1925 he was given the Sylvester Medal by the Royal Society, for his work *Principia Mathematica.* He is one of the leading authorities in the sphere of mathematical physics and his publications exhibit one of the greatest excursions in pure reason in the history of thought. For sheer intellectual effort in the most abstract yet fundamental regions of thought there are very few things comparable to the work he has already accomplished The scientific foundation of metaphysical speculation is his especial field; and in many domains his knowledge begins where that of other experts leaves off. He is an intellectual pioneer, dwelling on the farthest unexplored frontiers of thought; and of late he has been irresistibly drawn to the philosophy of religion, bringing to these problems a mind filled with scientific knowledge and fresh as the morning Every subject that he treats he touches with new life; he has in the highest degree learning, originality and intellectual charity. America is proud of the presence of such a man.

President Angell. Because she desires to honor great learning and extraordinary insight, and not less to recognize a rare ability to render significant and interesting to the intelligent layman scientific and philosophical issues ordinarily regarded as hopelessly abstruse, Yale confers upon you the degree of doctor of science and admits you to all its rights and privileges.

Sir James Colquhoun Irvine

Professor Phelps Principal of St. Andrews Born in Glasgow, he took his bachelor's degree at St. Andrews with special distinction in chemistry and zoology; his doctorate he took at Leipzig He became professor of chemistry and later dean of the faculty of science at St. Andrews, and in 1921 principal and vice-chancellor. In 1925 he was knighted, the list of his honors, degrees and decorations need not be given in detail. In the chemistry of the sugars he is one of the foremost living authorities, but nothing human is strange to him. He restored to its original condition the university chapel, where services were held before the time of Columbus. He is beloved by the leading men of letters of Great Britain, and was the only man in the world who could have persuaded Sir James Barrie to make a speech. He secured the great dramatist to deliver a baccalaureate address at St. Andrews, his first appearance on the platform. Principal Irvine's interests and sympathies extend as far as humanity; he is a first-class amateur

actor, a lover of music and the fine arts, a Scottish humorist and a conversationalist *summa cum laude* Such a personality can not be defined or even known by any special learning; for research is simply one of his natural activities We are happy to number him among the sons of Yale

PRESIDENT ANGELL In recognition of your striking accomplishments as an executive, your well earned renown as an unofficial ambassador from Scotland to other lands less bonnie, including England, but primarily by reason of your brilliant and solid achievements as a chemist, Yale confers upon you the degree of doctor of science and admits you to all its rights and privileges

George Hoyt Whipple

PROFESSOR PHELPS Dr Whipple was born in New Hampshire, took his B A at Yale in 1900, his doctor's degree at the Johns Hopkins Medical School and became a member of the faculty Research professor in the University of California, his work attracted such attention that when the new medical school was established at Rochester he was called as director He designed the buildings, selected the faculty and has brought the institution into deserved distinction His own special field of research is pathological anatomy His Puritan inheritance has been tempered by Baltimore, Charleston and California, so that he has lost its angularities without losing its grit

PRESIDENT ANGELL Because she wishes honorably to recognize your outstanding career in the field of your profession and to voice her confident expectation of further high service from you in your present responsible post, your alma mater confers upon you the degree of master of arts and admits you to all its rights and privileges

William Buckhout Greeley

PROFESSOR PHELPS: A graduate of the University of California in 1901 and of the Yale School of Forestry in 1904, he is chief forester in the U. S Forest Service He was attached to the Corps of Engineers in the world war, serving in France two years He was promoted to be lieutenant colonel of the 20th Engineers and chief of the Forestry Section. He received the award of the Distinguished Service Medal of the U S., the Legion of Honor of France and the Distinguished Service Order from Great Britain. His judgment of men is as good as his professional knowledge, it can never be said of him that he can not see the forest for the trees

PRESIDENT ANGELL. Latest of the distinguished line of graduates of the Yale School of Forestry who have acted as chief forester of the United States, in recognition of your distinguished services to your profession and to your country, your alma mater desires to honor you by conferring upon you the degree of master of arts and admits you to all its rights and privileges

GRANTS FOR SCIENTIFIC RESEARCH OF THE AMERICAN MEDICAL ASSOCIATION

THE Committee on Scientific Research of the American Medical Association has made grants for research which include the following.

Dr Victor C. Jacobsen, professor of pathology in Albany Medical College, to study the effects on living tissues of high voltage cathode rays ($1,200)

Mr. Charles V Green, of the Michigan State College of Agriculture and Applied Science, to study the inheritance of hemophilia and color blindness in man Mr Green will work under the immediate direction of Dr Charles B Davenport ($750)

Dr W H. Manwaring, Stanford University, California, to continue work on the physiological relationship of anaphylaxis to immunity, studied by means of blood transfusions and organ transplantations ($500)

Dr Arthur M Yudkin, assistant clinical professor of ophthalmology, to be used in the section of ophthalmology at Yale University to investigate the chemical and physical composition of the intra ocular fluids in experimental animals and also the changes which may take place as a result of cataract formation produced experimentally ($500)

Dr O Larsell, of the University of Oregon Medical School, to aid in his research on the homopoietic effects of nuclear extractives The fund will be applied toward determining which ingredients of the nuclear material are responsible for the stimulation of blood formation which has been observed in experimental and human anemias. ($500)

Dr Harold Cummins, associate professor of anatomy to Tulane University, who will be a guest worker for a part of the summer in the Carnegie Laboratory of Embryology, to study with the aid of the extensive material assembled in this laboratory, the history of the contours of the fetal hand and foot, with particular reference to individual variation and the correlated development of skin patterns

Dr J Earl Else, of the Else Dudman Nelson Clinic of Portland, Oregon, to study the reconstruction of the lower end of the esophagus.

Roy L Moodie, of Santa Monica, California, to enable him to prepare for publication the illustrations for a discussion of surgery in pre Columbian Peru.

SCIENTIFIC NOTES AND NEWS

DR VICTOR C VAUGHAN, formerly dean of the Medical School of the University of Michigan, has been awarded the Kober Medal, given by the Association of American Physicians for distinguished work in preventive medicine and public health.

THE French Society of Electricians has presented its Mascart Medal to Sir Joseph Thomson

DR. LUDWIG PRANDTL, director of the Kaiser Wil-

helm Institute for Aeronautical Research in Gottingen, was awarded a gold medal on the occasion of a lecture that he gave recently before the Royal Aeronautical Society of London

M Paul Helbronner, known for his geodetic work in the French Alps, has been elected a member of the Paris Academy of Sciences, to fill the vacancy caused by the death of Haton de la Goupillière

Dr George H Whipple, dean and professor of pathology, University of Rochester School of Medicine and Dentistry, was awarded the honorary degree of doctor of science by Colgate University at its recent commencement

The degree of doctor of science has been conferred by De Pauw University on Dr William Albert Riley, head of the department of animal biology of the University of Minnesota

Ohio Wesleyan University, at the recent commencement exercises, conferred the degree of doctor of science on Eugene Wesley Shaw, geologist for the Standard Oil Company of South America.

The University of Leeds has conferred the honorary degree of doctor of science upon Dr A. G Perkin, professor emeritus

The following degrees will be conferred by Birmingham University Dr A C Seward, Downing professor of botany in the University of Cambridge, Dr Arthur Lapworth, professor of chemistry, University of Manchester, Sir David Ferrier, emeritus professor of neuropathology, King's College, London, Sir Watson Cheyne, Bart, and Sir Walter Fletcher, secretary of the Medical Research Council

The list of honors conferred by the King of England on the occasion of his birthday on June 3, as given in *Nature*, includes the following names of men of science and others associated with scientific work *Order of Merit* The Honorable Sir Charles Parsons, in recognition of his eminent services in scientific research and its application to industries *G B E (Civil Division)* Sir Frank Heath, until recently secretary to the Department of Scientific and Industrial Research, and Sir Richard Threlfall *K B E (Civil Division)* Dr C E Ashford, headmaster of the Royal Naval College, Dartmouth *Knights* Mr W G Lobjoit, until recently controller of horticulture, Ministry of Agriculture, and Professor C J Martin, director of the Lister Institute, London *C M G* Professor R W Chapman, professor of engineering in the University of Adelaide *C I E* Mr A G Edie, chief conservator of forests, Bombay *C B E (Civil Division)* Mr D J Davies, government analyst, Department of Public Works, Newfoundland. *O.B.E. (Civil Division)* Mr. G W Grabham, government geologist, Khartoum, Mr T. F Main, deputy-director of agriculture, Bombay, and Mr. V. E. Pullin, director of radiological research, War Office

Professor William A Waldschmidt, assistant professor of geology in the Colorado School of Mines, for the past five years, has resigned from the faculty in order to accept a position in the geology department of the Midwest Refining Company, Denver

Dr Malcolm H Bissell has resigned as associate professor of geology at Bryn Mawr College and will spend next year as an honorary fellow in geography at Clark University

Sir Humphry Rolleston, Bt, regius professor of physic, has been appointed to represent the University of Cambridge at the third Imperial Social Hygiene Congress at Westminster from October 3 to 7

Professor Fulleborn, of the Hamburg Institute for Tropical Diseases, has been invited by the Argentine government to visit South America to study hookworm disease

The Rawson-MacMillan expedition, being sent out by the Field Museum of Natural History, sailed from Wiscasset, Maine, on June 25, for Labrador and Baffin Land This expedition is being financed by Frederick H Rawson, of Chicago, and is led by Commander MacMillan Among the members of the museum staff who sailed with the party are William D. Strong, Alfred C Weed, Arthur G Rueckert and Sharat K Roy The party will remain in the Arctic for fifteen months and will establish a shore station in the Eskimo village of Nain, Labrador

Erich F Schmidt, assistant in archeology in the department of anthropology of the American Museum of Natural History, has joined the field party of the Oriental Research Institute of the University of Chicago, to assist in an archeological reconnaissance of Asia Minor

Dr. Waldemar Jochelson, who has been the guest of the American Museum of Natural History during his visit to America, is now preparing to return to Russia, where he has accepted a position as division curator of the Museum of Anthropology and Ethnography of the Academy of Sciences, Leningrad, and as lecturer on ethnology at the Leningrad University.

Dr. Charles A. Kofoid, chairman of the department of zoology of the University of California, has left Berkeley to attend the international congresses on zoology and genetics in Europe, and to visit the leading scientific laboratories of Northern and Central

Europe At the International Zoological Congress in Budapest, Hungary, which takes place in September, he will read a paper on "Human Intestinal Protozoa and their Relation to Diseases in Man" From that meeting Dr Kofoid will go to the International Congress of Genetics in Berlin, Germany

DR ALFRED N RICHARDS worked last year at the National Institute of Medical Research in London, having been granted leave of absence from the chair of pharmacology in the University of Pennsylvania Medical School

THE non-resident lecturer in chemistry under the George Fisher Baker Foundation at Cornell University for the first term of the year 1927–1928, October 1, 1927, to February 1, 1928, will be Dr Paul Walden, professor of chemistry and director of the chemical institute of the University of Rostock While at Cornell, Professor Walden will lecture upon Non-Aqueous Solutions, Stereo-Chemical Problems and Optical Inversion, and will hold a weekly colloquium

DR ALFRED ADLER, Vienna, will give the introductory lecture at the fourth International Congress for Individual Psychology, which will take place in that city from September 17 to 19 The first session will be devoted to the subject of "The Prevention and Treatment of the Psychoses" Sunday will be devoted to the prevention and treatment of problem children and criminals, and Monday to lectures by prominent scientists of Vienna The lectures will be in English, French or German

SIR JOSEPH THOMSON, O M, delivered the tenth Sylvanus Thompson memorial lecture before the Röntgen Society, London, on June 14, taking as his subject "The Structure of the Atom"

A BUST of Emil von Behring was recently unveiled in the hall of honor of the University of Mexico, of which he had been made a doctor *honoris causa* in 1910

PINEL, the French specialist in mental diseases, died in 1826, and, on May 30, 1,277 scientists and physicians met at the Sorbonne to pay tribute to his memory He was regarded as the first to treat insanity as a disease and apply humane methods of treatment

AFTER the death of Sir William Macewen, professor of surgery in the University of Glasgow from 1892 to 1924, a committee was formed to promote a fund for the purpose of commemorating his life and work The first purpose of the fund was to procure a bust for presentation to the university and a replica to Lady Macewen. The second purpose was the establishment of a Macewen Memorial Lecture, and the third the foundation of a Macewen Medal in the Class of Surgery We learn from the *British Medical Journal* that the busts have been presented to the university and to Lady Macewen and the medal has been founded and the first award made The first memorial lecture was delivered by Professor Harvey Cushing, of Harvard University

A BRONZE bust of the late Alexander Smith, for many years professor of inorganic chemistry at the University of Chicago, has been recently presented to the university by Mrs Smith *Industrial and Engineering Chemistry* states that as the late Professor Nef was the founder of the department of chemistry and as Professor Stieglitz shared equally with Professor Smith in assisting Professor Nef in the upbuilding of the department, it has seemed fitting that the university should also possess busts or paintings of Professors Nef and Stieglitz and a movement to provide funds for these has been started by a committee of graduates of the department The busts or paintings of the three men will ultimately be placed in the library of the George Herbert Jones Laboratory, the new research chemistry building about to be erected Contributions to the fund should be sent to Dr J W E Glattfeld, of the department of chemistry of the University of Chicago, who is treasurer of the committee

DR JOHN G WILLIAMS, a specialist in roentgenology and a pioneer in Brooklyn in the development and use of deep X-ray therapy, died on July 2, aged fifty-four years

Nature reports the death on May 30 at the age of ninety-five years of Surgeon-General Henry Cook, formerly dean of the faculty of medicine of the University of Bombay

THE deaths are also announced of Dr G von Tschermak, emeritus professor of mineralogy and petrography in the University of Vienna, aged ninety-one years, and Dr Anton Wassmuth, formerly professor of mathematical physics in the University of Graz, aged eighty-two years.

WE learn from *Nature* that Corpus Christi College, Cambridge, has celebrated the two hundred and fiftieth anniversary of the birth of the Reverend Stephen Hales, who was born in 1671, died in 1761, and was buried in the south transept of Westminster Abbey For fifty years Hales was curate of Teddington, and it was there he wrote his "Vegetable Statics" of 1727 A fellow of the Royal Society and a foreign member of the Paris Academy of Sciences, Hales's scientific work took a practical turn, and he was instrumental in improving the ventilation of ships

and prisons, his work on which entitles him to be called a public health pioneer.

A MEETING was held recently in the American Museum of Natural History with the object of establishing in New York City an astronomical society for amateurs and was presided over by Dr Clyde Fisher Professor Henry Fairfield Osborn, president of the museum, made the welcoming address. Other speakers were Dr Oswald Schlockow, district superintendent of public schools of New York City, Mr John A Kingsbury, secretary of the Milbank Memorial Fund, and Mr. George H Sherwood, director of the museum Of the audience present, 340 signed applications for membership Dr Fisher was elected temporary president

THE Sigma Zeta chapter of Sigma Pi Sigma National Physics Fraternity was installed at William and Mary College, June 2, with seventeen charter members Professor H E Fulcher, of Davidson College, Davidson, N C, was in charge of the installation A banquet was held after the installation and addresses were made by Dr R C Young and others

THE thirty-second annual conference of the Bunsen Society for Applied Physical Chemistry was held in Dresden, from May 26 to 29, under the presidency of Dr Mittasch, of Ludwigshafen

THE fifty-sixth annual meeting of the American Public Health Association will be held at Cincinnati from October 17 to 21, with headquarters at Hotel Gibson In conjunction with it the Ohio Society of Sanitarians and the Ohio Health Commissioners will hold their annual meetings Each of the nine sections of the association—laboratory, health officers, vital statistics, public health engineering, industrial hygiene, food and drugs, child hygiene, public health education and public health nursing—will hold individual section meetings In some instances two or more sections will combine for joint meetings The topic for discussion at the forum session is "Has Prohibition promoted the Public Health," Professor C.-E A Winslow, of Yale University, presiding One session will be given to the discussion of mental hygiene from the angle of the home, the school and the industrial field. An analysis will be made by a special committee on the health programs in operation in normal schools and colleges and will be supplemented by constructive suggestions Dr Herman N Bundesen, health commissioner of Chicago, Dr William H Park, of the New York City Health Department Laboratories, Dr Clarence E Smith, of the U S Public Health Service, and C W Larson, of the U. S Department of Agriculture, are among the specialists asked to give the most recent developments in the sanitary production and handling of milk. Several luncheon and dinner meetings will be held by sections, including laboratory, public health engineering, industrial hygiene, food and drugs and public health education. Besides a special session on venereal disease control, a round-table luncheon conference has been scheduled Trips to points of interest in and around Cincinnati have been arranged by the local committee

THE *Journal* of the American Medical Association reports that under the auspices of the Swiss Goiter Committee, an international conference on goiter will be held in the aula of the university buildings in Berne, Switzerland, on August 24, 25 and 26 The president of the conference, Dr H Carrière, will give the opening address on the general distribution of goiter, and among other speakers will be Professor L. Aschoff, Freiburg; Dr David Marine, New York, Professor de Quervain, Berne, Dr McCarrison, Cooroon, India, Professor Galli-Valerio, Lausanne, and Professor Wagner von Jauregg, Vienna The assembly will be welcomed by the officials of the canton and the city of Berne There will be a demonstration in the surgical clinic by Professor F de Querin, on August 27, and in the afternoon a trip to the poor farm with a demonstration of cretins The conference was first planned by the Swiss Goiter Committee in 1923, and had to be postponed until this year

THE Department of Agriculture will participate in the Arkansas River Flood Conference on July 14 and 15, at Tulsa, Okla E. A Sherman, associate forester of the Forest Service, S H. McCrory, of the division of agricultural engineering of the Bureau of Public Roads, and H. H Bennett, of the Soil survey, of the Bureau of Chemistry and Soils, will represent the department in connection with phases of flood control which affect agricultural activities. At the conference, phases of flood control, particularly by means of reforestation, control or erosion by terracing, planting of cover crops, and by proper grazing, will be discussed.

THE U S Department of Agriculture announces that the new unit known as the Food, Drug and Insecticide Administration became effective on July 1; W. G. Campbell will be in charge. Congress created the Food, Drug and Insecticide Administration recently for the purpose of separating work involving scientific research from the work of law enforcement. The new arrangements involve no change in the policy of enforcement and other acts concerned. The laboratories of the Bureau of Chemistry that are now engaged on food and drug control work will operate under the new unit. Mr. Campbell was a lawyer before joining the department of agriculture about twenty years ago. P. B Dunbar, Ph D., the assistant chief of the new unit, entered the service of the Bu-

reau of Chemistry in 1907, and since 1925 has been assistant chief.

THE Accademia dei Lincei of Rome, founded in 1603, has received an annual donation of $4,275 from the Rockefeller Institute for the purchase of scientific periodicals.

THE 250,000th Leitz Microscope has recently left the works. It has been a traditional policy to give each 50,000th microscope to an institution or individual responsible for the development of science These microscopes, which represent milestones in progress, have been presented as follows The microscope bearing serial No. 50,000 to the German Tuberculosis Sanatorium in Davos, Switzerland, the microscope No 100,000 to Dr Robert Koch, in Berlin, the microscope No 150,000 to Dr Paul Ehrlich, in Frankfurt, the microscope No 200,000 to Dr. Martin Heidenhain, in Tubingen, the microscope No 250,000 to the Institute for Tropical Hygiene, in Hamburg

SURGEON-GENERAL HUGH S CUMMING, U S Public Health Service, has arranged through the deputy minister of health of the Dominion of Canada for a board of officers of the public health service to visit Montreal to make an intensive survey of the typhoid situation in that city, and to secure the facts as to the source and extent of the outbreak The board will secure such information as might be needed to enable it to submit recommendations to prevent the spread of typhoid from Montreal into the United States The officers detailed on the board are Surgeons Leslie L. Lumsden, James P. Leake and Clifford E Waller, and Sanitary Engineer H R Crohurst, all men of experience as sanitarians in the public health service

THE work of the branch laboratory of the Bureau of Entomology, Department of Agriculture, at Tallulah, La., has been seriously hampered by the Mississippi flood, according to a statement issued by the department. The substance of the announcement follows. A report received from this station says, in effect "We are very busy salvaging things . . Evidently our air field will be under water for a long time yet, possibly a month, but the water has fallen enough so that we are able to start moving out our dusting machinery. . . All electrical equipment is, of course, ruined, but the remainder of the machinery has not rusted much Delicate parts are ruined. . There are two areas near here which were not overflooded, owing to protection from small private levees, and we think we can soon get started in these areas on our important research work, especially the hopper. One stretch of deep water will probably have to be crossed by boat all summer. . . . All experiments south of Tallulah will have to be reached by boat for a long time, as the highway there is under ten feet of water in some places yet." Another laboratory of the bureau, situated at Baton Rouge, La., is on high ground, not affected by the flood, and none of the experiments in progress there have suffered.

UNIVERSITY AND EDUCATIONAL NOTES

THE cornerstone of the new teaching hospital of the University of Pennsylvania's Graduate School of Medicine, to be built at a cost of $2,000,000, was laid on June 14 In conjunction with the remodeled Polyclinic Hospital buildings, the new plant will completely replace the former Medico-Chirurgical, Polyclinic and Diagnostic Hospital plants, which have become merged as parts of the Graduate School of Medicine.

THE Medical College of Virginia, Richmond, as a residuary legatee, will receive from the Martha Allen Wise estate approximately $130,000 for the care and treatment of patients at the St Philip Hospital, a large modern colored institution owned and operated by the college for teaching purposes

THE Eli Lilly and Company of Indianapolis have recently given to the University of Kansas School of Medicine a research fellowship for the special study of hypertension, under the supervision of Dr Ralph H Major, head of the department of internal medicine The fellowship amounts to $1,800 a year and was recently given to Mrs Vera Johnsmeyer Jones

THE University of Edinburgh has received a gift of £40,000 from Mr Thomas Cowan, a shipowner of Leith, to assist in furthering the success of the scheme for the establishment of a residential house for male students attending the Edinburgh University Mr Cowan's previous gifts to the university, amounting to £30,000, are being applied to provide a hall of residence for students, which is to be called Cowan House

DR G CARL HUBER, dean of the Graduate School of the University of Michigan, has been appointed to succeed the late Dean Alfred H Lloyd

DR. ELMER A HOLBROOK, for the past five years dean of the School of Mines and Metallurgy at the Pennsylvania State College, has resigned Dean Holbrook is to become dean of the combined engineering and mining school at the University of Pittsburgh.

ROLLAND M. STEWART, professor of rural education, has been appointed director of the Agricultural Summer School of Cornell University, to take office after the close of the school this summer, which will be under the direction of Professor George A Works, who will next year become dean of the Library School of the University of Chicago

NEW appointments at the Medical College of Virginia, Richmond, include Dr. William B Porter, professor of medicine, Dr Sidney S Negus, professor of

chemistry; Dr J C Forbes, assistant professor of chemistry, Dr Lewis C Punch, associate in pathology, and J G Jantz, associate in anatomy

At Armstrong College, Newcastle, Mr Clement Heigham has been appointed professor of agriculture, in succession to the late Professor D A Gilchrist, and Dr. J W Heslop Harrison to be professor of botany, in succession to Professor J W Bews, who has resigned

DISCUSSION

MEAN SEA-LEVEL AS AFFECTED BY SHORELINE CHANGES

It seems to have been quite generally assumed that carefully made tidal observations, extending over a period sufficiently long to eliminate the disturbing effects of meteorological and astronomical causes, will give a value for mean sea-level which at any given place will remain essentially constant As mean sea-level determinations afford the only satisfactory basis for detecting slow elevation or subsidence of the continent, the validity of the assumption noted is a matter of no small importance

A number of years ago the writer became convinced that the mean sea-level surface bordering an irregular shore is itself an irregularly warped surface, and that its elevation changes appreciably with changes in the form of the shoreline Special studies of this problem are now in progress, and a full discussion will be published at an early date It is desired here to indicate briefly some of the facts upon which the theory of a fluctuating mean sea-level surface is based The facts are not novel, but their consequences seem not fully to have been appreciated, especially by those citing records of mean sea-level observations as proof of slow continental subsidence or elevation

We may begin with the simple and obvious case of a bay connecting with the open sea by a narrow inlet and receiving the waters of inflowing rivers It is known that under such conditions the influx of river water will raise the mean level of the bay A striking example of this phenomenon is presented by Kennebecasis Lake or Bay, which receives the waters of the St John River and connects with the sea at St John, New Brunswick, by the very narrow tidal channel famous for producing the "reversible falls"—from the sea into the embayment when the tide outside is high, from the embayment back into the ocean when the tide outside is low According to the Canadian hydrographic authorities, the mean level in the embayment is at least two feet higher than the mean level outside There can be no doubt that many such embayments along our coasts have abnormally high mean levels, the excessive elevation generally amounting at most to but a few inches, but in some cases rising as high as a foot or more What would happen if storm waves, tidal currents, or other agencies widened or deepened the inlets between sea and embayment, or created additional inlets, so that better egress of waters from the embayment to the sea would be insured? Obviously the ponding of the river waters would be less effective, and the mean level of the embayment would fall Thus would be created, within the embayment, fictitious indications of an uplift of the land Or suppose that the inlet were gradually narrowed or shallowed through the deposition of débris by wave or tidal currents, so that the escape of the river waters was more and more obstructed In this case *the mean level within the embayment would gradually rise*, and one would find there fictitious indications of a gradual subsidence of the coast

Let us consider next the case of mean sea-level as affected by prevailing wind directions It is not difficult to understand that if the wind blows constantly in a given direction, the level of a water body over which it blows must be permanently distorted with an abnormally low level toward the windward shore, and an abnormally high level along the lee shore A land mass separating two water bodies so affected will have distinctly different mean water levels on its two sides If one of the water bodies be the ocean, and the other a bay or lagoon separated from the ocean by a bar through which a very narrow inlet permits restricted ebb and flow of the waters, the difference in mean levels on the two sides of the bar will persist If, however, the inlet be widened, or if new inlets be broken through the bar, the water levels will approach equality, and this will result in a fictitious indication of land elevation on one side of the bar, and a fictitious indication of subsidence on the other

It can be shown that tidal conditions alone, unaffected by either river inflow or wind direction, will produce local inequalities of mean sea-level which are subject to fluctuations with changes in the form of beaches and inlets To take a single example, imagine a bay or lagoon separated from the sea by a bar through which a narrow inlet admits the rising ocean so slowly that high tide in the lagoon never rises as high as high tide in the ocean. When the ocean waters fall, the waters in the lagoon will flow back into the ocean, but so slowly that before the lagoon is emptied the ocean waters begin again to rise. Thus low tide in the lagoon is always higher than low tide in the ocean, just as high tide in the lagoon is always lower than high tide in the ocean. Now such tidal

inlets are usually broader at the top, and narrower below, with the result that the waters enter and leave the lagoon most freely when the tide is high. As a consequence, the discrepancy between high tide levels in the two water bodies is not so great as that between the low tide levels, and the mean level of the lagoon is therefore higher than the mean level of the ocean. Changes in the number or breadth of inlets much cause changes in the mean level of the lagoon, and such changes are of common occurrence.

The shallowing or deepening of inlets, the growth of bars across the mouths of bays formerly free from such shore features, or the destruction of bars by storm waves, the narrowing of inlets by sand-spit growth, their widening by wave or current action, or the breaching of bars by new inlets formed by storm waves or by the outburst of impounded land waters, any and all of these must be potent causes of local changes in mean sea-level in harbors, bays or lagoons where are found conditions approximating those described above. Nor do the conditions described exhaust the list of those which may give rise to local differences in mean sea-level. They are merely examples intended to illustrate the fundamental principle that local changes in the form of the shore may, under appropriate conditions, produce local changes in mean sea-level. Such changes in mean sea-level may be gradual or sudden, depending on the nature of the shore changes responsible for them, and they may amount to fractions of an inch or to a number of inches, depending on the form and size of inlets and bays and on the range of the tides. Where gradual and imperceptible, yet of significant amount, they are apt wrongly to be attributed to progressive, slow coastal subsidence or coastal elevation.

DOUGLAS JOHNSON

COLUMBIA UNIVERSITY

QUANTITATIVE DETERMINATION OF ROCK COLOR

THE need for standardization of rock colors has been realized by many petrographers. Sedimentationists, especially, have desired a color standard. In meetings of the Sedimentation Committee of the National Research Council, the possibility of basing important deductions as to alteration and environment of sediments upon slight color differences has been suggested. The difficulty in investigating these suggestions has been the lack of means of detecting the requisite small color variations. The best standard of colors now in use is the Ridgway chart. In fact, its use in sedimentation has become so desirable that the Sedimentation Committee has taken steps toward the preparation of a more simple and cheaper chart, based on that of Ridgway, but especially adapted to field and laboratory descriptions of sediments.

Because the writer does not know of any application of quantitative color measurements to geologic investigation, he believes that the attention of mineralogists, petrographers, sedimentationists and others interested in color work should be called to the fact that instruments are available by means of which colors can be analyzed and synthesized quantitatively. No details of the construction and manipulation of these colorimeters need be given here for this information can be supplied by the dealers selling these instruments. Their wide range of application is indicated by their successful use in industrial plant control and research in a variety of industries including dye, paint, varnish, ink, and soap manufacturing, sugar refining and other industries. Since these instruments have proved their usefulness in practice, it is believed that they will be found to be useful also in the field of pure science wherever color is involved. Their value in petrographic research has been demonstrated by the writer in his study of the relationship between structure and color of the shales of the Cromwell Oil Field of Oklahoma.

The most simple and obvious method of determining rock color by direct comparison of rock fragments with a standard color chart is at best only qualitative. Comparisons of streaks produced in the usual way by drawing fragments of the material over an unglazed porcelain plate enable smaller color differences to be detected than is possible with the use of chips but this method is also unsatisfactory. Streaks vary with slight differences in hardness and texture of the rock as well as with differences in composition. The texture, hardness and whiteness of the streak plate and the pressure applied in obtaining the streak are also significant variables. Moreover, such a streak can not be representative of the sample as a whole because it involves too small a quantity of material and it has the added disadvantage of being neither reproducible nor easily preserved for future reference.

Many of these difficulties can be overcome, as was done in the study of the Cromwell shales, by selecting an average sample, grinding the rock and sieving it. A portion of the powder passing the one sixteenth millimeter screen can then be pressed into a cardboard frame, previously mounted on a datum card, and covered with an ordinary thin cover glass. Black binding tape such as is used in preparing lantern slides serves to hold the glass to the rest of the mount. Such a record is permanent and can be filed. It overcomes the objections of the above-mentioned methods, but it too has some disadvantages. First, the mounting of the powders is time-consuming and,

secondly, after all this work has been done, the color differences detectable by the eye are not always sufficiently small to be of value in the investigation. The fundamental need, a method of greater sensitivity, remains

Such was the case in the Cromwell problem when a timely advertisement in SCIENCE called the writer's attention to the color photometer In order to test the applicability of the instrument to the study of the shales in question, the writer submitted samples of shale powders passing the one sixteenth millimeter screen to the dealer for trial tests. The results agreed so well with certain chemical determinations that the writer believes that he is warranted in suggesting the use of the color photometer in other investigations When the investigation of the Cromwell shales is completed, it is hoped that the application of quantitative color data to petrographic research will be demonstrated conclusively As stated in the beginning, the purpose of this brief paper is merely to make better known a color-determining device applicable to liquids, powders and massive solids, both heterogeneous and homogeneous, capable of giving quantitative data which can be presented graphically Such an instrument may prove of great value in other geologic problems such as those dealing with changing environments under which sedimentary beds have been deposited, color changes produced in rocks during metamorphism, and in other types of investigation The color of mineral streaks can now be placed on a quantitative basis Doubtless, other applications will suggest themselves to the reader

OLIVER R GRAWE

MACKAY SCHOOL OF MINES,
RENO, NEVADA

A NEW FUNDAMENTALIST STRONGHOLD

"THE Des Moines University, Des Moines, Iowa, is now the property of the Baptist Bible Union of North America A President has not been elected, but in the meantime the Board of Trustees announce that no one will be retained on the faculty who is not a Christian in the sense of having been born again Some professors will teach no longer in the university because their views are decidedly modernistic No professor will be retained who believes in evolution, or who does not accept the Bible as the infallible word of God The highest educational standards will be maintained Des Moines University will teach the supernaturalism of Christianity as opposed to the naturalism of modernism which is prevalent to-day"

The above, taken from a publication of the Baptist Bible Union, is published because the situation should be thoroughly understood by scientific men. Twenty of the faculty, including two deans, have resigned. The writer, who a year ago accepted a two-year contract as professor of biology, with the promise of freedom in the teaching of evolution is among those leaving

N M. GRIER

HATHAWAY PARK,
LEBANON, PA

QUOTATIONS

STEEL TURNS TO RESEARCH

SCIENCE is to work for the United States Steel Corporation To be sure, the greatest organization of its kind in the world has long had its laboratories, but it has been their main function to make more or less routine analyses and to control the processes whereby ore is converted into hundreds of products ranging from wire to girders No startling discovery in the chemistry of iron and steel stands to their credit The corporation has made its greatest technical strides in engineering—in lowering production costs, in introducing new machinery, in increasing tonnage Convinced, no doubt, by the example of other large industrial organizations and above all by Sir Robert Hadfield, of Sheffield, and the great German ironmongers, the United States Steel Corporation has decided to create a department of research and technology under the direction of Dr John Johnston, of Yale, a scientist ably qualified by technical education and experience to explore a field in which scientific and industrial honors are to be won

Judge Gary's announcement of what his board of directors must have regarded as a daring innovation is phrased with characteristic but guarded optimism. The finance committee is to keep an eye on the research laboratory While the corporation "has no money to waste intentionally," Judge Gary comments, "we have money to expend if necessary" Miracles are not to follow the rubbing of the lamp of science by a chemical Aladdin "We do not expect you can go along at a very rapid rate to begin with, or, perhaps, at any time, but we will have patience, as you must all have patience"

Some research is better than none, particularly if the spirit in which it is conducted is that of the university. How successful the new department of research is destined to be must depend largely on the policy adopted Such experienced directors of research laboratories as Dr W R Whitney, of the General Electric Company, and Dr C Kenneth-Mees, of the Eastman Kodak Company, have argued for an absolutely free hand. Money-making must not infect the laboratory. Paradoxically, the most money is

made by laboratories least concerned with it—by men who have dabbled in the Einstein theory and the mysteries of the Bohr atom and stumbled on principles applicable to industry If purely commercial standards are to guide the research director he finds it difficult to attract men of the finest scientific type His net result is merely a heightening of technical efficiency, an improvement in finished products Grant a laboratory the right to work untrammeled and both science and industry gain It was the adoption of this large-visioned policy that made the discovery of ductile tungsten possible—a discovery that unexpectedly gave us electric lamps of an economy and brilliancy undreamed of twenty years ago, radio tubes that have made broadcasting and television twentieth century triumphs, and deeply penetrating X-ray tubes that have been a boon to the sick

The richest assets of some of our largest corporations are not their physical properties but the discoveries made in laboratories where research has been conducted for its own sake Perhaps because these assets can not be even approximately appraised, at least one corporation carries its priceless patents on its books at the valuation of one dollar—*The New York Times*

SCIENTIFIC BOOKS

The Ferns (Filicales) Vol II *The Eusporangiatae and other relatively Primitive Ferns* F O BOWER, Sc D, LL D, F R S, pp 344, many figures Cambridge, the University Press 1926

FOR more than forty years Professor Bower has been recognized as a leader in the study of the Pteridophytes, and this work, the second volume of a comprehensive treatise on the ferns, of which the first appeared in 1923, is especially welcome to those, who in these days when morphology is rather discredited still feel that the subject not only is far from exhausted, but will again be revived when some of the current botanical fashions are out-moded

The present volume treats in detail the Eusporangiatae and the more primitive families of the Leptosporangiates, and is a contribution of the first importance. It records the latest conclusions of the author as to the structure and classification of the ferns

Not the least valuable feature of the present volume is the attention paid to the fossil ferns, as well as to the living ones, and the comparison of the latter with their ancient relations is constantly borne in mind in an endeavor to construct a system of classification which, approximately at least, will represent the true genetic relationships, and throw light upon the origin of the existing ferns

Professor Bower recognizes three types of sporangium-development, and on this basis he arranges the families in three categories, *viz* Simplices, in which all the sporangia of a sorus are formed simultaneously, Gradatae, in which they are of different ages, formed in basipetal succession, and Mixtae, in which sporangia of different ages are mingled in the same sorus The Simplices are the most primitive, the Mixtae the most specialized

There are two types of sorus, marginal and superficial, *i e*, borne on the lower surface of the leaf. The marginal sporangia are believed to be the older type, although the superficial sori are characteristic of the Marattiacae as well as of some other paleozoic ferns The present volume deals with the Simplices and Gradatae, of which fourteen families are recognized

Before considering the living ferns, a chapter is devoted to a group of fossils, Coenopteridaceae, which have no existing representatives There are three families of these Botryopterideae, Zygopterideae, and Anachoropterideae They are all confined to the Palaeozoic, occurring from the Upper Devonian to the Permian

The author concludes that the Coenopteridaceae include an assemblage of more or less synthetic types which may probably be assigned to the Filicales, but which do not show any close relationships with existing ferns

Of the living Filicales, it is pretty generally admitted that the two Eusporangiate families, Ophioglossaceae and Marattiaceae, are the most primitive

In his earlier writings Professor Bower separated the Ophioglossaceae from the Filicales, but in the present work he has restored them to a place among the ferns, where there is no doubt they belong It is true that their exact relationship with the other ferns is not easy to determine

While almost nothing is known of the geological history of the Ophioglossaceae, there is very strong evidence that they are the most primitive, and presumably the oldest, of the living ferns There seem to be sufficient resemblances to the fossil Coenopterideae to warrant the assumption of a remote relationship with that order

Although a very full description of the external morphology is given by the author, there are certain points that might be criticized In the discussion of the venation in Botrychium, for instance (p. 43), Professor Bower emphasizes the difference between the open venation in Botrychium and the reticulate venation of Ophioglossum, but he fails to note the two types of venation found in Botrychium, although he figures these The simpler, and probably more primitive species, *e g*, *B Lunaria*, *B simplex*, have "Cyclopteroid" venation, while the larger species show a

midrib and lateral veins like those of the typical ferns Now the transition from the cyclopteroid venation of Eu-botrychium to the simple reticulate venation of the cotyledon of *Ophioglossum Moluccanum,* for example, is not a very great one A similar transition from the open venation to the reticulate is shown by Professor Bower in Marsilea (p 179, Fig 461) In short, the contrast between the venation in Ophioglossum and Botrychium is not so marked as Professor Bower believes

The statement (p 57), "In the ontogeny of the Pteridophytes a coherent body of tissue called the stele, partly made up of elements having a truly cauline origin, exists from the first, and it serves to connect up adjacent leaf-traces," is certainly open to question A most careful study of the ontogeny of Ophioglossum, especially *O Moluccanum,* has shown as conclusively as possible that the whole of the vascular skeleton of the axis is of foliar origin and that there is no truly cauline stelar tissue This is true also for Botrychium and probably for Helminthostachys, as well as for the early stages, at least, of the Marattiaceae

It may be said that Professor Bower seems to be aware of the difficulty in harmonizing the stelar theory with the conditions that exist in Ophioglossum

Professor Bower's studies on the development of the sporangium in the Ophioglossaceae are quite the most complete that have been made, and are amply treated in the present volume One may venture to differ from his conclusions in one particular, *viz*, the nature of the sporangial spike There is good evidence that this is not an appendage of the leaf, but a structure coordinate with the whole sterile segment. Both in *Ophioglossum Moluccanum* and *Botrychium Lunaria* there is a dichotomy of the very young leaf primordium, the branches forming respectively the fertile and sterile segments

A sufficiently complete account of the gametophyte is given, but the embryo and young sporophyte, especially in Ophioglossum, are not treated as fully as might have been wished Why the young sporophyte in *O Moluccanum,* with its functional cotyledon, should be considered less primitive than that of the other species in which the early leaves are rudimentary, is hard to understand, nor will the conclusion that Ophioglossum is less primitive in structure than the other genera be accepted without question Space will not permit a fuller discussion of these points

The very distinct order Marattiaceae is of particular importance in the phylogeny of the ferns, since unlike the Ophioglossaceae, to which they are undoubtedly related, there are abundant fossils obviously allied to living forms

In the later Palaeozoic, fern-like fronds with sori similar to those of existing Marattiaceae are found, and in the older Mesozoic rocks occur fossils much like the living genera.

The statement (p 102) that the very young sporophyte of Danaea is "protostelic," is incorrect, as there are several distinct xylems belonging, respectively, to the leaf traces which have united to form the solid stele

The relationships of the Marattiaceae to the other ferns are difficult to determine They seem to be relics of a Palaeozoic and Mesozoic stock which have come down to the present with little change and have not given rise, directly at least, to any of the existing Leptosporangiates

In the enumeration of the number of living Marattiaceae (pp 124–125), there is an obvious typographical error Christensenia (Kaulfussia) has only two species, not 26, as indicated in the table

To some extent intermediate between the true Eusporangiatae and the Leptosporangiatae is the small family Osmundaceae with two genera, Osmunda and Todea, and 17 species Like the Marattiaceae, the living species are but remnants of a once much more extensive order The earliest fossils of Osmundaceae are in the Permian, where perfectly preserved stems closely resembling the structure of living species are found

The intermediate character of the Osmundaceae is shown in the gametophyte, embryo and sporangia, as well as in the anatomy of the adult sporophyte This is excellently summarized on page 148

The three remaining families of Simplices, Schizaeaceae, Gleicheniaceae and Matoniaceae, like the Osmundaceae, are undoubtedly relics of once much more predominant types Of these the Schizaeaceae lead up to the series of Leptosporangiates with marginal sori, while the Gleicheniaceae are the most primitive of the series with superficial sporangia.

The Gleicheniaceae, and the related Matoniaceae, are very uniform in their structure, but the Schizaeaceae differ greatly among themselves, and their relations to the other ferns, both living and fossil, are by no means clear Possibly going back to the Carboniferous, and certainly to the Jurassic, they show great variety both as to external form and anatomy. Their sporangia, however, are quite uniform in type.

Probably an offshoot of the Schizaeaceae are the heterosporous Marsileaceae, which agree closely with the Schizaeaceae in their anatomy and in the development of the sporangia.

During the Mesozoic, especially the Cretaceous, species of Gleichenia were abundant in the northern regions, extending even to West Greenland. Fossils resembling Gleicheniaceae occur in the coal measures, but there is some doubt as to their real nature.

The first family of the Gradatae, the Hymenophyllaceae, is a very natural one, all of the nearly 500

species being referable to the two closely related genera, Hymenophyllum and Trichomanes Their geological history is obscure, but the latest conclusion is that the family is not an extremely old one Their nearest relationship is probably with the Schizaeceae

Formerly included in the Hymenophyllaceae is the monotypic genus Loxsoma from New Zealand, but it has now been separated as the type of a separate family, Loxsomaceae, which also includes three species of a recently described second genus, Loxsomopsis Professor Bower believes that the Loxsomaceae are related to the Dicksoniaceae

The most radical change in classification is the separation of the Cyatheaceae, to which most of the tree-ferns belong, into three families, *viz*, Dicksoniaceae, Protocyatheaceae and Cyatheaceae, the latter including only the three genera, Cyathea, Hemitelia and Alsophila The Dicksoniaceae have marginal sori, and are believed to have no relation to the Cyatheaceae, in which the sori are superficial The family Protocyatheaceae is proposed to include two genera, Lophoria and Metaxya.

Professor Bower notes a remarkable peculiarity of the young sporangia in Metaxya and the Cyatheaceae in which they differ from all other ferns that have been investigated, *viz*, the apical cell of the young sporangium is two-sided, instead of three-sided Figure 55 suggests the segmentation in the antheridium of a moss.

The family Plagiogyriaceae is proposed to include the single small genus Plagiogyria It is to some extent a synthetic type, intermediate between the Gradatae and Mixtae. "It is a relatively primitive type, but not very closely allied downwards to any one of the known primitive Ferns"

The last family discussed in the present volume is the Dipteridaceae, with the single genus Dipteris, as to whose relationship there has been some controversy

The final chapter is an excellent summary of the conclusions reached from the detailed study of the different families. This chapter includes maps showing the present distribution of several of the most important families, as well as their occurrence in a fossil condition. There is also a diagram showing the relationships of the families discussed in the text

Professor Bower's long continued and exhaustive investigations in the development of the sporangium have made him the leader in this important subject, and he has treated it admirably in the present volume It is this perfect mastery of the subject which makes his classification, based mainly upon sporangial characters, so satisfactory. There will probably be little dissent from his conclusions.

One could wish that less space had been devoted to the elaborate details of stem-anatomy, and somewhat more to the gametophyte and embryo-sporophyte, especially to the question of the origin of the vascular system

The conclusions reached by recent studies on the origin of the vascular tissues of the Eusporangiatae point to a foliar origin for the bundles of the axis, and these results are hardly given adequate attention by Professor Bower It is by no means unlikely that further investigations on the vascular bundles of the Leptosporangiates will show that in them also, there is no "stele" in the sense used by the author

Professor Bower is to be congratulated on the completion of the second volume of this very important undertaking, and the final one will be looked forward to with the keenest interest To all students of the Pteridophytes these volumes will be indispensable.

DOUGLAS HOUGHTON CAMPBELL
STANFORD UNIVERSITY, CALIFORNIA

SPECIAL ARTICLES

THE INFLUENCE OF X-RAYS ON THE DEVELOPMENT OF DROSOPHILA LARVAE

DURING the past two years we have been engaged in carrying out experiments the results of which we have hoped would give some definite data concerning certain fundamental aspects of radiation effects on biological processes As a preliminary report we wish to present some of the observations made on the influence of X-rays on a given biological process, namely, the development of Drosophila larvae into pupae The larvae employed in our experiments have been raised from an original culture of Drosophilae obtained from Dr J H Northrop who had grown these flies under aseptic conditions for many generations, and we have maintained the same conditions

Our procedure, briefly stated, has been to wash larvae (mean age, 2.5 days) out of a seeding flask on to a piece of aseptic voile, then to transfer them by a method of random sampling to wells in paraffin blocks, or to paraffin permeated pill boxes (in which case the boxes were then set in wells in paraffin blocks) A Kelly-Koett X-ray machine, supplied with 12 5 cm spheres for spark gap, has been used throughout.

We observed that the larval stage was significantly prolonged, and that the fraction of the total number of irradiated larvae reaching the pupal stage was sensibly the same as for controls, when the conditions of irradiation were as follows Spark gap 2 cms distance between spheres, M. A., 8; target distance, 30.5 cms. Three experiments were then performed in each of which three lots of larvae were irradiated

for the same period (one hour) to test the reproducibility of this effect

The values obtained for the mean duration of the prepupal period, expressed in days, were as follows

Experiment	*Irradiated*	*Controls*	*Difference*
1	8 35	5 18	3 17
2	8 37	5 04	3 33
3	8 04	4 83	3 21

In another group of experiments larvae were irradiated with radiations, a larger proportion of the energy of which was due to radiations of short wavelength The conditions of irradiation were as follows Spark gap 8 cms between spheres, M A, 5, target distance 54 cms, filter 1 0 mm aluminum and 0 5 mm copper The X-ray bulb was contained in a lead drum with a circular aperture of 13 5 cms diameter The periods of irradiation were varied, being 50, 100, 150, 200, 250 and 350 minutes, respectively, the corresponding mean duration of the prepupal period, *expressed in days,* being 5 76 ± 0 08, 6 02 ± 0 04, 6 39 ± 0 11, 6 77 ± 0 05, 7.02 ± 0 10, 7 46 ± 0 08, 7 87 ± 0 12, while the value for the controls was 5 63 ± 0 05 (where the precision measure is the a d and the number of independent observations for each irradiation interval was four) *These data indicate that the mean duration of the prepupal period is an increasing function of the period of irradiation, under otherwise fixed conditions of irradiation, at least within the interval studied.*

These results suggested the possibility of observing an effect of the radiations just described when employed in a manner similar to that utilized in determining "depth dosage" in radiation therapy, where either water or paraffin phantoms are used in conjunction with the ionization chambers placed at various depths To this end paraffin blocks were prepared, 25 by 25 by 2 5 cms with cylindrical wells at the center of one of the large faces of each These wells were 2 5 cms in diameter and 0 5 cm deep The larvae to be irradiated were selected from a batch of prepared larvae by a method of random sampling and distributed in the wells mentioned above and in a similar well utilized for the controls, aseptic technique being employed throughout The wells were then covered with a piece of paraffin-permeated paper and sealed, following which perforations were made in the paper lid The blocks were now stacked so that the edges of the square faces coincided and the wells were accordingly co-axial Previously air vents had been arranged in the paraffin for ventilation which was facilitated by the use of an electric fan The stacked blocks were so placed under the X-ray bulb that the centroid of the target lay on the common axis of the cylindrical wells

Experiments were performed in accordance with the procedure just outlined, in which the period of irradiation was six hours and the distance from the target to the upper face of the top paraffin block was 54 cms The resulting mean duration of the prepupal periods, *expressed in days,* for the larvae in the various blocks was as follows 8 37, 7 90, 7.16, 6 47, 6 17, while the mean value for the controls was 5.57 days

Obviously, it would be desirable to have a measure of the time of irradiation required to produce the same extension of the mean prepupal period in the different layers rather than or in supplement to the data given above We have been unsuccessful with experiments of this kind, because the facilities for producing a sufficient radiation intensity available at present in our laboratory are such that the period of time required to effect significant changes in the larvae irradiated at the lower levels is so great that it is disadvantageous to maintain the larvae in the unnatural environment In the experiments performed so far we have not obtained reproducible results

We hope that in the near future we shall have the necessary facilities for completing these experiments and extending our work to include observations of other biological processes in the same as well as in other systems Such experiments will undoubtedly lead to a better understanding of how radiations affect biological processes and it is possible that methods may be made available which will permit the measures of biological effects and those of ionization effects to be contrasted

R. G HUSSEY
W. R THOMPSON
E T CALHOUN

DEPARTMENT OF PATHOLOGY,
YALE UNIVERSITY

THE ANTI-STERILITY VITAMIN E AND POULTRY[1]

HERBERT M EVANS and George O Burr,[2] of the University of California, stated in a paper presented at the Washington meeting of the National Academy of Sciences, and reported in Volume LXI, No 1585, SCIENCE, that "sterility is a dietary deficiency disease for it can be cured or prevented by a change in dietary régime, a change involving the addition of certain single natural foods high in a food factor or the addition of very much smaller amounts of extracts of those foods" The work reported was with rats.

In this report they state that Vitamin E is present

[1] Published by approval of the Director of Agricultural Experiment Station as Technical Paper No. 47.

[2] "Anti-Sterility Vit. E," Evans and Burr, SCIENCE, 61, 519–520, May 15, 1925.

but extremely low in milk fat and that cod liver oil is notably lacking in Vitamin E and that throughout the life of the animals 9 per cent by weight of the ration may be constituted of cod liver oil and yet sterility results

Vitamin E has been found to exist in oats, corn and especially wheat. The wheat germ is said to have an extraordinary richness of E Vitamin Other feeds reported to contain it are lettuce, dried alfalfa, pea seedlings, rice, yellow corn, rolled oats, velvet bean pod meal, egg yolk and cooked meat

Katherine Scott Bishop, of the University of California, assisting Herbert M Evans, and Barnett Sure, of the University of Arkansas, have carried on experiments leading to the same conclusions as those reported in SCIENCE on a diet composed of milk casein for protein, cornstarch for carbohydrates, lard for fat and the proper mineral salts, with the addition of a little butter for Vitamin A, yeast for B, orange juice for C and cod liver oil for D The rats grew normally and thrived but they failed in fertility [3]

The addition to the dietary of a little lettuce or rice enabled the rats to reproduce Four successive generations have been raised on such a synthetic diet

Evans and Bishop have found that the male as well as the female is affected by the lack of this substance and they have been able to extract it from favorable foods by alcohol and ether

Recent experiments conducted at the University of Idaho on the influence of hatchability of certain feeds of high vitamin content and certain animal protein feeds indicate that nutritional conditions affecting hatchability in chickens apparently differ from those in other animals. In these experiments the hens all received wheat for their scratch feed During 1923–1924, the basal mash (B) was composed of equal parts of wheat bran, shorts, cornmeal and ground oats, to which was added two pounds of charcoal and four ounces of salt per one hundred pounds. In addition to the mash the birds received grit, oyster shell and water. This ration was lacking in animal protein content The no-high vitamin feed pen received no feeds in addition to this ration. The dry yeast pen received 2 per cent. dry yeast in the mash and the cod liver pen received 2 per cent. of medicinal cod liver oil in the scratch feed. This oil was mixed into the wheat about every five days.

During 1924–1925, the basal ration was changed Twenty per cent peameal was added to the mash and unlimited sour milk was given No water was available to the hens. This ration (A) contained ample animal protein content for egg production In 1924–1925 they had the run of pens 8′ x 40′. During 1925–1926 the ration was the same, but the birds were confined the entire year During 1924–1925 and during 1925–1926, the lawn clippings pen received five pounds of lawn clippings per one hundred birds daily These lawn clippings contained blue grass and Dutch white clover and had been cured in the sun and then sacked They were soaked in water before being fed During 1925–1926, alfalfa leaves and blossoms, prepared in a similar way, were fed in one pen Both the lawn clippings and alfalfa leaves and blossoms may have some Vitamin D content due to the method used in preparing them

The following table shows the results of the experiment during the three years, 1923–1926

TABLE I

INFLUENCE OF CERTAIN VITAMIN FEEDS ON HATCHABILITY

Feed	Basal Ration B — No Animal Proteins: Year	Per cent hatch ability	Basal Ration A— Animal Proteins: Year	Per cent hatch ability
Cod liver oil			1924–25	61
	1923–24	26	1925–26	57 9
No vitamin feed			1924–25	26
	1923–24	24	1925–26	37 4
Dry yeast			1924–25	38
	1923–24	30		
Lawn clippings			1924–25	54
			1925–26	59.6

SUMMARY OF AVERAGES

Feed	Years	Per cent hatchability
Cod liver oil	1923–26	48 3
No vitamin feeds	1923–26	28 1
Dry yeast	1923–25	34
Lawn clippings	1924–26	56 8

During 1923–24, when the ration was low in animal protein feeds, none of the pens gave good hatchability The addition of feeds of high vitamin content to this ration was of little value of increasing hatchability During 1924–1925, the hatchability in the no-high vitamin and dry yeast pens was very poor, while in the cod liver oil and lawn clippings pens it was high. The addition to the ration of animal proteins in the form of sour skim milk was apparently an important factor During 1925–1926, when the birds were confined during the entire year and the ration again contained sufficient animal proteins the no-high vitamin pen again gave very poor hatchability compared to pens getting cod liver oil, lawn clippings and alfalfa leaves and blossoms.

[3] "Fertility Vitamin," E E. Slosson, *Sci. Monthly*, 18 447–8, April, 1924

Additional experiments involving the influence of different animal protein feeds on hatchability bring out some very interesting and valuable results Sour skim milk has proved especially valuable Pens getting sufficient vitamins rarely give poor hatchability when the birds are getting unlimited sour skim milk It is necessary, of course, that other conditions be right.

The extensive experiments in the feeding of poultry at the University of Idaho Agricultural Experiment Station show conclusviely that reproductive disorders in poultry can not be remedied by simply adding wheat, yellow corn, oats or other feeds which have been found to contain Vitamin E From the nutritional viewpoint, a combination of factors is necessary for maximum hatching power In addition to the feeds that the breeding stock are given, there apparently are many other important influences [4]

RAYMOND T PARKHURST

IDAHO AGRICULTURAL
EXPERIMENT STATION

THE AMERICAN ASSOCIATION OF MUSEUMS

THE twenty-second annual meeting of the American Association of Museums was held in Washington, D C, from May 23 to 25 The marked feature of the conference was the extent to which the program was in the hands of members and delegates rather than of scheduled speakers This circumstance, and the almost complete absence of questions of business, which, during the recent years of association growth have so absorbed attention, produced a meeting of unusual profit

Coming at the end of the fourth year of the association's work since permanent headquarters were established, the meeting gave opportunity for an appraisal of progress The reports of officers indicated that the organization has now emerged from the class of experiments and has taken its place squarely in the ranks of established institutions Its progress has been partly in the nature of financial development, accompanied by increased service, and partly of broadened outlook attendant upon the growth of projects Among the undertakings completed are the Yosemite Museum—erected by the association and now turned over to the Federal Government, an important traveling exhibit of industrial art objects brought from the recent International Exposition of Decorative and Industrial Arts and circulated to the larger art museums of the country, reports of two surveys of European museums; a field study of small museums in this country, and a report of this work in the form of a "Manual for Small Museums"

The report of the treasurer showed total income for all purposes to be \$56,277 41 and total disbursements to be \$41,915 98

Among new projects undertaken during the meeting were an effort in cooperation with the National Education Association to secure the services of a specialist on school museum relations, and establishment of a demonstration small museum A course of training for museum work, which has been under contemplation for some time, was announced for next fall, and progress was reported in the development of a clearing-house service for exchange and redistribution of museum collections

The general sessions of the conference were held on three successive mornings—at the Smithsonian Institution, the American Red Cross National Headquarters—where the Red Cross Museum is located—and the Corcoran Gallery of Art, respectively One principal paper on each morning was followed by a full discussion and a series of committee reports. There was an outdoor afternoon session following luncheon at the Great Falls of the Potomac, an evening devoted to simultaneous sessions on art, science and history problems, and a final banquet at which the speakers were Dr E. E. Lowe, of Leicester, England, representative of The Museums Association of Great Britain, Lorado Taft, of Chicago, and Dr. L O Howard, of Washington, D C The presidential address was delivered by Chauncey J. Hamlin, president of the Buffalo Museum of Science

The free discussion, which figured so prominently in the meeting, was responsible for two impromptu sessions devoted to educational work—a subject of outstanding importance to museum workers at the present stage in the development of their technique. The ranks of museum educational workers were supported by a number of school representatives, whose presence indicated a new tendency on the part of school boards to inquire actively into museum cooperation

Officers were elected for the coming year as follows:

President, Chauncey J. Hamlin, Buffalo

Vice-presidents, Fiske Kimball, Philadelphia; Arthur C. Parker, Rochester, Charles R. Richards, New York, and George H Sherwood, New York.

Secretary, William deC Ravenel, Washington.

Treasurer, George D Pratt, New York.

LAURENCE VAIL COLEMAN,
Director

[4] "The Feeding and Management of Breeders," R T Parkhurst, Agricultural Experiment Station Circular No 44, April, 1927.

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MEDICAL RESEARCH AND ITS ORGANIZATION[1]

OCCASIONS such as the one in which we are participating are peculiarly significant They mark the advancement of knowledge—its principles and practice —through a training of both the mind and the hand in the power to comprehend and extend knowledge All knowledge comprises one vast domain, there is to-day scarcely a line of separation between the pursuit of the knowledge called "humanistic" and that called "scientific" The object is one, since in both what is sought is the interpretation of nature, whether in the physical world about us or in the mind and spirit within In all these fields, we are now used to exercise the privilege of free inquiry and to substitute for authority the evidences of our perceptions

This high privilege is on the whole a recent acquisition Although we date our intellectual freedom from the Renaissance period, it is fruitful to reflect on the diverse ways in which the revival of learning in the fourteenth, fifteenth and sixteenth centuries affected on the one hand the development of letters and art, and on the other that of science The interest awakened in the literature of Greece and Rome was shown in the admiration not only for the works of poets, historians and orators, but also for those of physicians, anatomists and astronomers In consequence, scientific investigation was almost wholly restricted to the study of the writings of authors like Aristotle, Hippocrates, Ptolemy and Galen, and it became the highest ambition to explain and comment upon their teachings, almost an impiety to question them Independent inquiry and the direct appeal to nature were thus discouraged, and indeed looked upon with the utmost distrust if their results ran counter to what was found in the works of Aristotle and Galen [2]

It is not without significance for us that it was the anatomists of the sixteenth century who broke with tradition and determined to examine the human body for themselves, and it was owing chiefly to the labors of two independent geniuses, contemporaries for a time at the University of Padua, Galileo and Harvey, working in very different spheres, that the old order was overthrown and a new era inaugurated

For medicine as well as for the physical sciences

[1] Address made at the Convocation for the Conferring of Advanced Degrees, Brown University, June 14, 1927.

[2] Harvey, W., "Motion of the Heart and Blood in Animals," translated by Robert Willis, Everyman's Library, 1906; Introduction by E. A Parkyn, p vii.

these two men were of supreme importance. From Harvey's discovery of the movements of the heart and blood vessels dates not only the science of physiology, but that of medicine itself It has been well said that this great discovery stands to medical practice much in the same relation as the discovery of the mariner's compass stands to navigation [3]

Harvey's epochal book was published in 1628 It seems probable that he began teaching his doctrines to his classes as early as 1616—the year of Shakespeare's death For more than ten years, Harvey delayed any formal publication of his experiments and deductions, meanwhile inviting criticism and opposition to his views from all sources, in order that the complete truth, free from any falsities and misconceptions, might be disclosed To-day as it did then, his modest treatise stands as a landmark in human history, and a perusal of the methods of experiment employed and the mode of presentation adopted arouses feelings only of admiration and emulation The fundamental thesis of Harvey's teaching is expressed in almost winged words by a modern physiologist [4] that only by searching out and studying the secrets of nature by way of experiments can we hope to attain in the words of Job "to a comprehension of the wisdom of the body and the understanding of the heart," and thereby gain that mastery of disease and pain which will enable us to relieve the burden of mankind.

The announcement of the discovery produced a sensation, it was opposed, but not by the younger physicians Among those who discerned its significance was the philosopher Descartes The material effect was not fortunate Harvey's medical practice fell off Patients feared to put themselves under the care of one accused by the ignorant and envious of being crack-brained, and of putting out new-fangled and dangerous doctrines This fate of great innovators is still not unknown There was fortunately one man in a high place who showed lively interest in the discovery Charles I supported Harvey and appointed him his personal physician It is interesting to reflect that this monarch, whatever opinion may be held of his other qualities, by aiding Harvey and Van Dyke showed himself an enlightened patron of art and science [5]

Hardly more than half a century separates the astounding figure of Harvey from the overwhelming figure of Newton—"the lawgiver of the universe" in the phrase of his contemporaries Both men were enemies of mere speculation, and upholders of the experimental method, and both were conspicuous by reason of the extreme caution with which they promulgated their discoveries Newton even less than Harvey was possessed of the passion, verging on fanaticism, for scientific discovery which has distinguished many men He had almost to be cajoled into the enunciation of the discovery of the law of gravitation, and he all but failed to complete the *Principia,* because he detested controversy.

"I see I have made myself a slave to philosophy; I will resolutely bid adieu to it eternally, except what I do for my private satisfaction, or leave to come out after me, for I see a man must either resolve to put out nothing new, or become a slave to defend it"

Newton's objectivity was extraordinary, in spite of the wonderful success of his theory he did not think that the law of gravitation was the final expression of gravitational phenomena—a piece of scientific caution which we have seen justified in our day

To those of us charged with the responsibility of searching out scientific aptitude, it is wholesome to learn that the reflective youth, unlike most great mathematicians, gave no evidence of mathematical precocity Even when at nineteen he entered Cambridge he had no definite intention of studying mathematics, it was the chance picking up of a book on astrology at a country fair which turned his mind in this direction, and yet when he took his B A. degree four years later he had discovered the binomial theorem and invented the differential calculus

The past one hundred years have seen the triumph of the experimental method, the deepest problems of which we are aware have been explored with confidence because of the perfection of method and of instruments of extreme precision In the physical world we stand in awe of the marvels being accomplished as, to take two or three spectacular examples, in the field of atomic structure, of radiology and of aviation The medical biological field is also being cultivated, with results no less significant perhaps for science as a whole

Since the greater speed of discovery has come with the last half century, it may be of interest to inquire briefly into some of the advances in medical science, with which subject I am myself more familiar. That this science should have lagged somewhat and indeed still grows more slowly than the mechanical and physical sciences need scarcely evoke comment. As was remarked by Claude Bernard,[6] "the object of science is

[3] Simon, Sir John, "Motion of the Heart and Blood in Animals," Everyman's Library, 1906, p ix, Editor's Introduction.

[4] Starling, E, *Lancet,* 1923, ii, 869

[5] Harvey, W, "Motion of the Heart and Blood in Animals," Everyman's Library, 1906, p xviii, Editor's Introduction

[6] Bernard, Claude, "An Introduction to the Study of Experimental Medicine," English Translation, 1927, p. 67.

everywhere the same. to learn the material conditions of phenomena. But though this goal is the same in the physico-chemical and in the biological sciences, it is much harder to reach in the latter, because of the mobility and complexity of the phenomena which we meet" Under these circumstances it is no wonder that at a period when the physical sciences were being enriched by experiment, medicine still remained a subject of philosophical systemization—a condition called by the philosopher Locke the Romance-way of physic, because it is more easy for men to build castles in the air of their own than to survey well those that are on the ground [7]

It is usual to date the beginning of what we are pleased to call the present or modern era of medical research from the establishment of the germ origin of disease In truth, no such sharp distinction as this is to be drawn, the germ theory of disease is a logical outgrowth of the state of development of chemistry and physiology in the middle period of the nineteenth century, and those two sciences had contributed then, as they continue to contribute in ever-increasing volume, to the store of biological knowledge

And yet there is truth in the view that new impetus and new hope were suddenly brought into medicine through the pregnant discoveries of Pasteur, Lister and Koch, which did so much to aid the growth of preventive and curative medicine The pursuit of microbiology, the science of the infinitely little, is still under full swing The quest has broadened greatly within the past few years The mere study of the elusive parasite has given way to a much more searching investigation of its intimate properties, its precise chemical constitution, on which depends its power for inflicting injury, and on a real understanding of which rests man's power of defense against harmful action, and the knowledge already gained in this difficult field is of very great significance The quest is also taking into account a remarkable capacity for variation among these minute parasites, affecting their propensity for inducing disease and raising far-reaching questions as to the origin of the parasitic forms and their relation to the far greater number of non-disease producing microbes with which man in common with all living things lives in intimate daily communion

The newer studies have brought the knowledge of parasite and host, the animal and plant, into closer and more equitable relationships, and have thus shown a way by which epidemics on an experimental scale may be profitably investigated among laboratory animals and made to yield information valuable in itself and even informing in respect to epidemics in man.

[7] Brown, John, Horae Subcivae, 1st Series, p. 19.

Perhaps no subject of wide investigation has yielded more startling and valuable information than that relating to the physiological effects of the so-called internal secretions If indeed we wish to correlate present-day outlook in medical practice with earlier happenings, we could choose no more fecund example than the master work of Claude Bernard on the sugar-liberating functions of the liver, to which he first applied the phrase Contemporary investigation by physiological and chemical means of this class of substances, the chemical messengers, or so-called hormones of the body, through which many of its functions are integrated, has been rich in surprising rewards. Almost everyone is familiar with the relationship of the "stunted, pot-bellied, slavering cretin,"[8] with defect of the internal secretion of the thyroid gland, and we stand awed before the now common fact of the transformation of the cretin into a normal, comely, intelligent child merely by the administration of the substance of the thyroid gland of animals. And we are growing familiar with the instances of gigantism and of excessive obesity, resulting from pathological conditions of the complex pituitary gland, the small body which sits on the fantastic Turkish saddle at the base of the brain The physiological effects as well as the practical uses of epinephrine, the peculiar secretion of the adrenal glands, would seem to bear daily testimony to that regulatory mechanism, through which fear is expressed and courage reinforced, while the saving graces of insulin, the hormone regulating the sugar consumption of the body, have rendered the lives of many thousands of victims of diabetes tolerable and happy This is a very incomplete list of even our present knowledge of these subtle, integrative, chemical messengers of health and disease Others regulate at the proper moment the order of the digestive secretions, determine secondary sexual characteristics, and even stand watch and ward over the generation of human life itself

There is no sharp line between health and disease, and no sharp distinction between the functions called physiological and pathological. A knowledge of the body will include all the biological processes with which we can deal The animal body has often been compared to a watch, and the physician with the expert watchmaker, and it has been hoped that in due time doctors will be as good at their craft as watchmakers are at theirs. It is true, of course, as John Brown, the gifted author of "Rab and his Friends," has pointed out, that the watchmaker is not called on to mend the watch while it is going, and that this makes all the difference. But the simile is far more

[8] Starling, E., *Lancet*, 1923, ii, 869.

imperfect than this, since the most cunning of Swiss watches which tolls the precise minute of the day or night, shows the day of the month, the quarters of the moon, and even other successive events, is so far simpler than the beautifully constructed and ingeniously integrated animal body, that it is almost an offense to compare one with the other

The vocation of medicine is multiple, hence the need for specialization In recent times, the scientific medical investigator has also become a specialist Since medicine is one of the biological sciences, it is natural to ally it with biology as an educational discipline But this definition has become too narrow The growth of medical science, as a biological science, has brought it into more and more intimate relationship, first with classical chemistry and now with classical physics, to the great benefit of both medicine and biology A generation ago we saw the rise of biochemistry as an independent subject of research and knowledge, to-day we are witnessing the beginnings of biophysics as a similar independent subject There is hardly a direction in which classical chemistry and classical physics are moving forward, in which biology and medicine do not promise presently to follow

These circumstances call for specially trained men possessing the temper and aptitudes of the investigator to pursue medical research Indeed, so formidable has become the demand for the investigation of medical problems that particular provision is being made in universities and special institutions founded to fulfill this demand On all sides the persons with these qualities are being scrupulously sought in increasing numbers In order to provide for them the most favorable opportunities for work, a kind of organization of research is being undertaken This is a new thing as a purely scientific experiment, and hence it may be well to inquire just what is embraced under the term of "organized medical research"

There are known conditions under which scientific discoveries have been made in the past The strong individuality of the gifted investigator is well illustrated by the two extreme examples dealt with at the beginning of this address It were futile to attempt any organization which purposes to promote discovery by such persons as these Indeed, it is not intended at all, and probably would prove impossible ever to organize the subject-matter of research and the extraordinary minds which are the chief means of making discovery It is now recognized that the progress of science, while strictly logical, is not uniform The whole body of scientific knowledge does not move and can not be moved forward on a wide front As a matter of fact, the reverse process occurs, progression takes place now at one, and now at another part of the front—after which, and perhaps slowly and with great effort, the rest of the column moves on In the meantime, still another thrust occurs, and now perhaps at a new part of the line, necessitating a still further general readjustment

And so with an infinity of pushes and pauses, owing to the efforts first of one and then of another group of investigators, and at different periods, one observes a larger problem to be cleared, but perhaps never completely solved As Newton has said, physical laws deal with relations between phenomena, not with causes, and causes need not be mathematical at all Moreover, the physical laws we enunciate must be regarded as provisional and approximate Hence the progress of science means the closer and closer approximation to the objective—perfect, immutable laws

The first indications of an experimental advance may occur many years ahead of the explanation of the phenomena involved, and until the latter appears, the real significance of the discovery may be missed Thus, Hopkins observed that small animals failed to develop normally on a carefully balanced, adequately caloric diet, not imagining the fault to lie with the want of almost imponderable quantities of necessary vitamines, substances still of elusive chemical composition, the existence of which at the time was unknown Now we designate with almost a half dozen letters of the alphabet as many supposedly vitamine entities which control as many physiological and pathological functions of the animal body

In like manner when the remarkable power of cod liver oil to prevent rickets in the young had been clearly shown, no one could have suspected that a like effect was produced by certain rays of the sun, and even less that in both instances the beneficial action is determined by a reciprocal, quantitative relation in the phosphorus-calcium content of the blood Just now that the study of radiation effects—of X-ray and of radium emanations—is claiming so much attention, we wish to ascertain what it is that takes place, which on the one hand leads to that kind of injury of animal cells that sometimes produces cancerous conditions, and on the other the beneficial changes that result in the actual cure of pre-existing cancerous growths That the radiations alter in some way the physiology of cells—normal or cancerous—may be assumed, it is the how that is being sought, and the nature of the alterations induced The ability to grow animal cells indefinitely outside the body has provided an almost perfect material for the biological testing of the effects of physical and chemical agents, from which in due time a new cell physiology will doubtless emerge

Among investigators the rarest are those men with

a presentiment of new truths; the far greater number merely develop and follow the ideas of others In a few instances the presentiment is extraordinary, but it is always likely to be a brilliant example of the scientific use of the imagination Of the first order of magnitude was Harvey's assumption of the existence of minute vessels uniting the arteries and veins and completing the circuit of the circulation In his day the microscope was too primitive to reveal them, in fact, Malpighi's discovery of the capillaries occurred four years after Harvey's death and thirty years after the publication of the "Motion of the Heart and Blood in Animals"

At all periods, voices have occasionally been raised to decry the domination of medicine by science These timid souls would return to the less aided senses in order to provide the so-called intuitive faculty of the physician with greater latitude Just now this thesis has been put forward by an eminent German surgeon—Sauerbruch—and an active controversy has been started The weight of opinion, fortunately, is more modern and logical, for while it is properly admitted that superficial science can never compensate for slipshod observation, and while it is allowed that one doctor's wits are sharper and quicker than another's, yet it is urged with easy conviction that without true knowledge even the supremely intuitive can reach no real goal nor pass beyond the limits of the "inspired ignoramus"

If, therefore, we may not seek to organize the subject-matter of research, we may nevertheless undertake to organize the facilities which make the prosecution of research more consistent and less a matter of chance In carrying out this purpose, we must ever keep in mind that the outstanding discoveries in science are the accomplishments of real men and usually of great men Now, as it has been well said, great men are just those who bring with them new ideas and destroy errors. They do not, therefore, respect the authority of their predecessors and they do not move in an ordered way. While it is of course true that the discoveries of the great men preceding them stand at the base of their own discoveries, yet neither is ever the promoter of absolute and immutable truths. "Each great man belongs to his time and can come only at the proper moment, in the sense that there is a necessary and ordered sequence in the appearance of scientific discoveries Great men may be compared to torches shining at long intervals to guide the advance of science. They light up their time, either by discovering unexpected fertile phenomena which open new paths and reveal unknown horizons, or by generalizing acquired scientific facts and disclosing truths which their predecessors had not perceived. If each great man makes the science which he vitalizes take a long step forward, he never presumes to fix its final boundaries and he is destined to be outdistanced and left behind by the progress of successive generations Great men have been compared to giants upon whose shoulders pygmies have climbed, who nevertheless see further than they This simply means that science makes progress subsequently to the appearance of great men, and precisely because of their influence The result is that their successors know many more scientific facts than the great men themselves knew in their day But a great man is, none the less, still a great man, that is to say—a giant"[9] And who would presume to confine, that is to restrict by organization, a band of giants? It is enough to provide them, as they may now hope to be provided, with suitable material resources with which to perform their gigantic, wonder-working tasks, of which they are often the unconscious agents This, and as it seems to me, this alone is the purpose and the justification for the organization of science to afford opportunity commensurate with the objects to be attained, for both the giants and their associates of smaller stature, for him who blazes the trail and him who clears the path, since both operations are needed in order that knowledge may be increased and the light be made to enter the still dark places, and the spirit of man be thereby enlarged and made to shine with ever greater brilliance

SIMON FLEXNER

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH,
NEW YORK, N Y

SCIENTIFIC EVENTS

THE CONVERSAZIONES OF THE ROYAL SOCIETY

THE first of the two conversaziones given annually by the Royal Society has taken place at Burlington House, when, as usual, an array of exhibits was provided for the instruction and entertainment of the visitors

According to an article in the London *Times* one of the most striking demonstrations was that of Mr. A A King, who showed the application of ultra-violet radiation from a mercury vapor lamp to the detection and estimation of minute quantities of arsenic When a mercury-arsenic stain on a piece of filter-paper sensitized with mercuric chloride is examined in ultra-violet light the unchanged mercuric chloride fluoresces blue, while the mercury-arsenic stains stand out as a black disc Arsenic stains,

[9] Bernard, Claude, "An Introduction to the Study of Experimental Medicine," English Translation, 1927, p. 41.

which are quite invisible in ordinary light, may be revealed in this way, and it is said to be possible to detect and estimate quantitatively amounts of arsenic as small as 0 00001 of a milligram Impurity in distilled water is also revealed by fluorescence in ultraviolet light, and it has not yet been found possible, even with the most refined methods of distillation, to prepare water that does not show some sign of fluorescence An exhibit from the National Physical Laboratory also illustrated the difficulty of preparing substances in a state of absolute purity It included specimens of iron, manganese and chromium, the impurities in which are detectable only with the spectroscope.

Another exhibit from the National Physical Laboratory showed the structure of pure mercury in the solid state, the metal being kept frozen by liquid air or carbon dioxide snow and acetone and etched with a solution of hydrochloric acid that does not freeze at the temperatures employed A collection of metallurgical specimens exhibited by Sir Robert Hadfield included sections from reinforcement bars of high tenacity non-corrodible steel, which are being used in the preservation work at St Paul's to replace the original wrought-iron bars put in by Sir Christopher Wren

Bolometers responding with remarkable rapidity to radiant heat were shown by Mr H Dewhurst, they consist of a narrow strip of bismuth, believed to be only 0.0000007 cm thick, deposited on thin celluloid films by electrical evaporation The thermostat of Lieutenant-Commander F J Campbell Allen and Mr. A E Salisbury depends on the fact that magnetic metals lose their magnetic properties at certain temperatures, in the apparatus an armature normally attracted by the metal drops as the temperature of the metal is raised, to be attracted again when the temperature falls.

Other physical exhibits included apparatus devised by Professor O W Richardson and Mr F S. Robertson for comparing the yield of soft X-rays from different substances, a demonstration by the British Thomson-Houston Company of the phenomena produced by an arc in a hot cathode discharge tube containing argon when tungsten vapor is injected, the Selényi method of measuring the vacuum in a lamp and new methods of using gas-filled photoelectric cells, one enabling very small illuminations to be detected without any delicate apparatus, and the other suitable for picture telegraphy, by the Research Laboratories of the General Electric Company, and apparatus for analyzing gases by means of high-frequency vibrations and for estimating flame temperature by spectrum line reversed, by the National Physical Laboratory.

AN INTERNATIONAL SOCIETY FOR THE STUDY OF PEATLANDS

AN international organization for the study of peatlands (Moorforschung) has been formed as a sub-commission of Commission VI of the International Society of Soil Science. The object is to promote peat investigations on an international basis and to coordinate and develop, in cooperation with governmental, state and private agencies such research and uniformity of methods in laboratory and field practices as are deemed in the interest of the fullest investigation, utilization and protection of peatland resources The work of the organization is to be carried on by the following officers: Dr A P Dachnowski, U. S. Department of Agriculture, chairman; Dr Hugo Osvald, director Peat Experiment Station, Jonkoping, Sweden, secretary, Professor Dr B Tacke, Germany, Colonel J Girsberger, Switzerland, Dr L. von Post, Sweden, Professor S H McCrory, Washington, D C, Dr F. J Alway, Minnesota, U S A, Dr W S Dokturowski, U S S. R. (Russia), Dr A Kirsanov, U S S. R (Russia).

Cooperation has been assured by an International Peat Committee which consists of leading members well known for their investigations in the geographical distribution of peatlands, in paleobotany, stratigraphy, agronomy, forestry, engineering and other special phases of peatland utilization.

The formation of the organization was initiated at informal conferences with directors of peat institutes and peat specialists in several countries of Europe The proposal was made and approved of holding a special peat session in the United States and organizing during the sessions of the First International Congress of Soil Science, held in Washington, June 13 to 22, 1927

The value of the special peat session just closed was shown by the interest in an exhibit of different types of peat and profile sections of peat areas, and by the commission's formal recognition of the advantages of genuine international action in common projects It aims at the coordination of fundamental peat investigations with the practical technique of utilizing areas of peat for different purposes. At its final session the Congress recommended to secure uniformity of methods of procedure for the investigation and handling of peatlands, with the ultimate aim of obtaining an accurate determination of the agricultural and industrial possibilities of peatland resources throughout the world.

Persons engaged in any aspect of this subject and desiring to associate themselves with the work of the international sub-commission are invited to join as members. Communications may be addressed to Dr.

A. P. Dachnowsky, U. S. Department of Agriculture, Washington, D. C.

AN AGRICULTURAL CENSUS OF THE WORLD

AN agricultural census of the world is planned under the direction of Mr Leon M Estabrook, of the International Institute of Agriculture at Rome Plans were prepared and approved by the general assembly of the institute in April, 1926.

Since June, 1926, Mr Estabrook has been visiting ministers of agriculture and heads of the statistical divisions of various governments in regard to the project

All European countries and surrounding countries, including Russia, Turkey, Syria, Palestine, Egypt and the North African Colonies, have promised cooperation in taking the census, France offering the most potential difficulties The European nations also promised to aid the institute in obtaining the cooperation of the colonies

Mr Estabrook is visiting Canada at the present time and will proceed to Mexico, Cuba, Jamaica, Haiti, Santo Domingo, Porto Rico, Panama and thence across the Pacific to Hawaii, Japan, China, Indo-China, the Philippines, Dutch East Indies, Australia, New Zealand, India and the countries west, including Arabia and others, to the colonies of eastern Africa He will then proceed to South Africa and thence to South America He hopes to return to Rome, having completed the circuit of the world and visited practically every country, in time for the meeting of the general assembly in October, 1928

This is the first attempt ever made to induce all countries to take an agricultural census Out of the 200 countries listed by the International Agricultural Institute, only 60 have ever taken an agricultural census and less than 40 have taken one since 1900 Of these not more than four happened by chance to take a census in the same year, and no two have taken their census in the same manner

If the present attempt is successful, the institute hopes to obtain funds for its continuation, with collection of statistics every ten years

Each country has agreed to pay for its own census and to issue its own report, which will be utilized in preparing the institute world report for each product.

THE GEOLOGIC SURVEY OF PENNSYLVANIA

THE Topographic and Geologic Survey of Pennsylvania is carrying on the following projects during the present field season in addition to the cooperative topographic work:

G. H. Ashley. Preparing a popular report on the rocks of Pennsylvania.

R. W Stone. Field work on building stones of Pennsylvania.

J. D. Sisler Detailed reconnaissance of the oil and gas fields of Pennsylvania.

Anna I. Jonas. Detailed areal mapping in the Middletown and York quadrangles, with some cooperation from George W Stose, of the United States Geological Survey.

Herbert Hughes Detailed areal mapping of the Freeport quadrangle.

Frank Leverett, of the United States Geological Survey Cooperative study of glacial geology, especially that outside the terminal moraine

George H Chadwick. Stratigraphic studies in the oil and gas region of northwestern Pennsylvania

Henry Leighton, University of Pittsburgh. Studies in the clay deposits of Pennsylvania of the Pittsburgh district, with field and laboratory studies by Professor J. B. Shaw at State College

Charles R Fettke and W. A. Copeland Detailed plane table mapping and studies in the Bradford oil field.

Freeman Ward, Lafayette College Areal studies of the sand and gravel deposits of Pennsylvania

Charles H Behre, Jr Detailed studies of slate west of Lehigh River

Arthur M Piper Underground water resources of northwestern Pennsylvania

On May 7 the state printery was nearly destroyed by fire The survey's remaining stock of bulletins was on the third floor of this building and practically all destroyed It is hoped that the more recent of these bulletins may later be reprinted from insurance funds

FIELD EXPEDITIONS OF THE UNIVERSITY OF CHICAGO

FIELD expeditions from the University of Chicago have started on divergent trails to study scientific records of America in anthropology, geology, archeology and paleontology.

Professor Fay-Cooper Cole, of the department of anthropology, will continue the extensive study of the Illinois mounds which he began last year. Illinois, according to Professor Cole, is the key state in anthropology for prehistoric America. His work this summer will be part of a program that may take ten years to complete. Information will be gathered on the mounds of the state by advanced students under his direction, and some preliminary excavations will be made.

Paul Miller, curator of Walker Museum, will continue his research on dinosaurs and other extinct animals in an area of east-central Wyoming.

Professor Edwin Sapir, of the department of anthropology, and Fang-Kuei Li, Chinese student, will

study the language of a group of Hupa Indians in northwestern California Li, who is specializing in linguistics, is working under the committee on American Indian languages of the Council of American Learned Societies He will teach Chinese at the university next year

A group of twenty-five students from a dozen universities and colleges met in June at the University of Chicago geological field station near St Genevieve, Missouri, for a period of intensive study under Professor Stuart Weller The site and buildings were presented to the university by W E Wrather, an alumnus

Professor J Harlen Bretz, also of the department of geology, will continue studies of an area of 12,000 square miles in Washington, south of the Spokane River and east of the Columbia Six graduate students and one undergraduate will assist him during part of the study

Several members of the department of geology will work under the State Geological Survey, Dr Paul McClintock continuing a detailed study of Illinois glacial deposits, and Dr Jerome Fisher studying oil and gas possibilities in the southeastern part of the state Associate Professor A C Noé, paleontologist, who is now in Russia engaged in the investigation of coal mines for the government, will later conduct a course on fossil plants in the coal fields of Illinois, Indiana and Kentucky

A field class under the direction of Professor Edson S Bastin, chairman of the department of geology, is now at work in the region of Devil's Lake, Wisconsin Later Professor Bastin will complete a study of fluorspar deposits of Illinois and begin work on the asbestos deposits south of Quebec

RESOLUTIONS IN MEMORY OF VICTOR LENHER

A MEMORIAL resolution in honor of Dr Victor Lenher, late professor of analytic and inorganic chemistry at the University of Wisconsin, was adopted at the last meeting of the faculty Introduced by Professors R Fischer, C K Leith and J H Mathews, it recalls the life and labors of Dr Lenher, who died on June 12, 1927, at the age of fifty-four years

Professor Lenher was called to the University of Wisconsin as assistant professor of general and theoretical chemistry in 1900, he was previously at Columbia University In 1904 he became associate professor and in 1907 he was made professor The resolution reads further.

For fourteen years he was a member of the board of education of the city of Madison, and for two years he was a member of the state board of health His constant interest in municipal and state affairs was of inestimable value to the city and to the commonwealth. During the early part of the world war, he interested himself in researches on gas warfare in collaboration with the bureau of mines and the gas service. Later he was commissioned as major in the chemical warfare service and served first as chief of university relations, and later as adjutant on the staff of Major General Sibert, director of the chemical warfare service He was honorably discharged, December 5, 1918

In the study of the chemistry of gold, tellurium and selenium, he reached preeminence His researches on the chemistry of these elements number over 60, covering a period of over twenty five years

The resolution eulogizes Professor Lenher as an educator and for his interest in students, and continues

In the death of Professor Lenher, the university has suffered an irreparable loss He came to the university at a time when strong, capable men were specially needed, the beginning of a period of rapid expansion He not only lived through this most interesting quarter century of development of the university, but contributed largely to the wise direction of that development His life, though shortened by an untimely death, was a full life and a happy one, he enjoyed his work, his students, his associates, and his family He has left an imperishable record of achievement of which the University of Wisconsin will ever be proud

SCIENTIFIC NOTES AND NEWS

DR WHITMAN CROSS, from 1888 to 1925 geologist of the U S Geological Survey, and Professor A G Hogbom, of the University of Upsala, have been elected foreign members of the Geological Society of London Professor F X Schaffer, University of Vienna, Professor C Schuchert, Yale University, Professor F Slavik, University of Prague, and Dr E O Ulrich, of the U S Geological Survey, have been elected foreign correspondents

DR ROBERT A MILLIKAN, of the California Institute of Technology, sailed for Geneva on July 11, to attend a meeting of the Committee on Intellectual Co-operation of the League of Nations

DR W D MATTHEW, who recently resigned as head curator of the geological sciences in the American Museum of Natural History, has arrived in Berkeley to take up his work as professor of paleontology and head of the department in the University of California

A COMMISSION from the medical faculty of the University of Havana is visiting the United States and Canada as the guest of the Rockefeller Foundation. The commission includes the following: Dr Solano Ramos, dean and professor of biological chemistry and chairman of the commission, Dr. Carlos Finlay, professor of ophthalmology, representing the clinical

subjects in medicine. Dr. Finlay's father was among the first to suspect that yellow fever was transmitted by the Stegomyia mosquito, Dr Aristides Agramonte, who has been acting dean of the medical school and who was a member of the original yellow fever commission, Dr Felix Martin, professor of the school of engineers and architects, who is in charge of planning for the new medical buildings to be erected by the Cuban University. The commission will spend about eight weeks visiting medical institutions in the United States and Canada

PAUL C MILLER, paleontologist in the Walker Museum of the University of Chicago, has been made a Knight of the Order of Danebrog by the King of Denmark.

WARREN K MOOREHEAD, director of the department of archeology at Phillips Academy, recently received the honorary degree of doctor of science from Oglethorpe University, in recognition of work in American archeology

DR EDWARD W ARCHIBALD, director and professor of the surgical department of McGill University, was recently made an honorary fellow of the Royal College of Physicians of London

THE title of emeritus professor of anatomy in the University of London has been conferred on Professor Edward Barclay-Smith as from the end of the session 1926–27, when he retires from the university chair of anatomy tenable at King's College

DR. EDWIN GRANT CONKLIN, professor of biology at Princeton University, has been elected a member of the board of directors of the American Eugenics Society.

DR H H DALE, head of the department of biochemistry and pharmacology in the National Institute for Medical Research at Mount Vernon and a secretary of the Royal Society, has been nominated to be for five years a member of the General Council of Medical Education and Registration.

PROFESSOR HENRY LOUIS, of Newcastle, was appointed by the council of the Institution of Mining Engineers at their summer meeting at Newcastle to succeed Dr. J. S. Haldane as president at the annual meeting in London in November

THE following have been elected officers of the Manufacturing Chemists Association for the ensuing year: *President,* Henry Howard, Grasselli Chemical Co, *Vice-presidents,* W. D. Huntington, Davidson Chemical Co; H. A Galt, Columbia Chemical Division, Pittsburgh Plate Glass Co.; *Treasurer,* Phillip Schleussner, Roessler & Hasslacher Chemical Co; *Secretary,* John I. Tierney, 614 Investment Bldg, Washington, D. C.

DR. E. W LINDSTROM, head of the genetics department of the Iowa State College at Ames, is sailing on August 5 for France to assist the directors of the European office of the International Education Board, particularly in their work in biology and agriculture His address for the next twelve months will be International Education Board, 20, rue de la Baume, Paris (8°), France

PROFESSOR C F BAKER has resigned, to take effect in November, from the College of Agriculture at Los Baños, Laguna, P I., with which institution he has been associated for many years He expects to spend next year with one of the Pan-Pacific research committees on the South Sea survey and thereafter will make headquarters at the University of Hawaii with President David Crawford Arrangements have been made to house his large collection of natural history material at the Bishop Museum

PROFESSOR C W HOWARD, who for the past ten years has been working on the upbuilding of the silk industry of Southern China, is returning from Canton to this country as head of the department of biology at Wheaton College A correspondent writes that beginning his work in the department of biology of the Canton Christian College, Professor Howard developed the work in sericulture to such an extent that the Chinese government established the Kwongtung Provincial Bureau for the Improvement of Sericulture under his directorship In response to the urging of the government officials, he will retain his connection with this work, returning to Canton for the summers for the next few years.

DR. WILLIAM H TALIAFERRO, professor of parasitology, and Drs Lucy Graves Taliaferro and Frances A Coventry, research associates in the department of hygiene and bacteriology of the University of Chicago, have returned from a three months' trip to Central America Through the courtesy of the United Fruit Company they spent most of their time working on the serology and immunology of malaria and various intestinal worms at the hospital of the Tela Railroad Company, in Tela, Honduras Dr Taliaferro has been invited to the school of tropical medicine of the University of Porto Rico as visiting professor of parasitology during the winter quarter of 1928.

PROFESSOR A S. HITCHCOCK, curator of the grass herbarium of the U S National Museum, left Washington on July 1 for two months' field work on the Pacific Coast, especially in the Olympic Mountains

DR. W. O RICHTMANN, professor of pharmacognosy at the University of Wisconsin and superintendent of the pharmaceutical garden of the Wisconsin Pharmaceutical Experiment Station, is abroad for a

three months' tour His principal object is to consult the British Museum and other libraries in connection with his study of the history of American medicinal plants and drugs

At the Montana College and Experiment Station President A Atkinson has been granted leave of absence for study during the next college year Dean and Director F B Linfield has been appointed acting president in his absence Dr Arnold H Johnson, assistant chemist in the station, has also been granted leave of absence for one year to accept a fellowship for study in Europe given by the International Education Board

Foresters and chemists from England, Australia, Sweden, Finland and Mexico, detailed recently to the U S Forest Products Laboratory of the University of Wisconsin, constitute the largest group of foreign research men ever gathered at the federal laboratory at one time. Included in the foreign research group are Wilhelm Rosen and Eric Ostlin, of the Scandinavian-American Foundation, J E Cummins and H S Dadswell, of the Australian Council for Scientific and Industrial Research, W G Campbell, of the Commonwealth (British) Foundation, Hermenegildo Barrios, of Mexico, and Uno W Lehtinen, of the Finnish State Forest Service.

Dr Harrison R Hunt, head of the department of zoology and geology at the Michigan State College, is making a lecture tour through the west in the interests of the American Eugenics Society He planned to lecture on eugenics and human heredity at the University of Omaha, Oregon State Normal School, State Normal School at Bellingham, Washington, and the State Normal School at Ellensburg, Washington

Dr Jack Cecil Drummond, professor of biochemistry in University College, London, vice-dean of the faculty of medical science, is among those lecturing at the American Chemical Society Institute at the Pennsylvania State College

The death is announced on May 15 of Dr Edwin B Payson, professor of botany in the University of Wyoming

UNIVERSITY AND EDUCATIONAL NOTES

Yale University has received a bequest of more than $150,000 from the estate of General Charles H Pine, formerly of Ansonia, which, together with a gift of General Pine's made in 1913, brings the Charles H Pine scholarship fund at Yale to a total of more than $215,000

At the commencement exercises of the University of Maryland gifts were announced amounting to $150,000 The largest gift was from Captain Isaac E Emerson, of Baltimore, who provided endowment for a professorship in the school of pharmacy and a fellowship in the school of medicine The University of Maryland during the coming biennium will have almost $1,000,000 for new buildings and improvements from the state.

The University of London has received two gifts of £10,000 each, one from an anonymous donor and one from Messrs Wander, Ltd, for the establishment of a university chair of dietetics

It is announced at Columbia University that Dr Durward R Jones, recently epidemiologist of the State Department of Health of South Dakota, will succeed Dr Alton S Pope as assistant professor of epidemiology, and that Dr Adelaide Ross Smith, recently physician to the New York State Industrial Board, will succeed Assistant Professor Frank G Pedley as associate professor of medicine in industrial hygiene Dr Smith will be in charge of the industrial department at the Vanderbilt Clinic of the College of Physicians and Surgeons Dr Pope is now epidemiologist of the Chicago Health Department, and Dr Pedley will assume charge of the new department of industrial medicine at McGill University Medical School on August 1

Eric Ponder, M D, Sc D, F R S, of Edinburgh, has been appointed associate professor of general physiology in New York University and will have charge of the courses in physiology in University College He will also direct work in general physiology in the graduate school

Dr Herbert O Calvery, instructor in physiological chemistry at the Johns Hopkins Medical School, has been appointed assistant professor of physiological chemistry at the University of Michigan

Dr D A Worcester has been appointed associate professor of educational psychology in the University of Nebraska

Dr N B. Dreyer, assistant professor of physiology, Dalhousie University Faculty of Medicine, has resigned to accept an appointment in the department of pharmacology at McGill University Faculty of Medicine, Montreal

DISCUSSION

MISUSE OF THE NAME "LEUCOSCOPE"

I ask the privilege of your columns in order to clarify a somewhat confused account of some work

of mine given in Walsh's "Photometry,"[1] pp 244–245 Since the same mistake has also been made by others heretofore and bids fair to become prevalent, it seems desirable to publish a correction I do this not for the sake of finding fault, but to prevent in so far as possible, the continued spread of mistaken ideas in regard to the subject-matter in question It is well known how errors once incorporated in a standard text are copied and recopied without limit

The error in question is that the instrument designated by Mr Walsh as "The Leucoscope" is *not* the leucoscope, but the "rotary dispersion colorimetric photometer" The pertinent facts are as follows

(1) The leucoscope is an instrument, the invention of which is commonly attributed to Helmholtz, about 1870–80[2] It consists essentially of a quartz plate between a *Wollaston* prism and a nicol prism through which the observer views *two* images of the *same source*

(2) The instrument which Mr Walsh describes, and calls "The Leucoscope" is properly called the "rotatory dispersion colorimetric photometer"[3] I particularly object to naming it "Priest's leucoscope" as is done in the index of Mr Walsh's book It is a special form of the Arons Chromoscope[4] and its embryonic form may be seen in Zoellner's colorimeter[5] My connection with this instrument has been to develop the theory and practice of its use in the colorimetry and photometry of incandescent sources and daylight, and to design an instrument especially suited to these purposes

(3) In principle, manner of use and specific purpose served, the two instruments are very different About all that they have in common is the fact that they both contain nicol prisms and quartz plates and the circumstance that I have written papers dealing with each of them separately

It seems unnecessary to use your space to set forth in detail the distinctions between these two instruments All confusion may be removed by consulting my papers which deal, respectively, with the two different instruments.[6]

IRWIN G PRIEST

[1] J W T. Walsh, "Photometry," Constable, London, 1926

[2] There has been some slight controversy as to the relative contributions of Helmholtz, and one of his pupils, Diro Kitao, to the development of the instrument Edm Rose (1863) described an instrument which may be regarded as the prototype of the leucoscope A review of the history of the instrument and a full bibliography have been published in my paper on the leucoscope, *Jour Op Soc. Am. 4*, pp 448–495, 1920.

[3] *J O. S A & R S. I 7*, folded insert facing p 1199, December, 1923.

[4] Leo Arons, *Ann der Phy* (4) *39*, pp 545–568, 1912

[5] J. C F. Zoellner, "Photometrie des Himmels," Berlin, 1861; G Mueller, "Photometrie der Gestirne," pp 244–254, Leipzig, 1897.

[6] "A New Study of the Leucoscope . ," *J. O S A. 4*, pp 448–495, November, 1920, "Colorimetry and Photometry . by the Method of Rotatory Dispersion," *J. O. S. A. & R. S I 7*, pp 1175–1209, December, 1923

TADPOLES AS A SOURCE OF PROTOZOA FOR CLASSROOM USE

IN SCIENCE, Vol 56, pp 439–441, there appeared a note by Dr R W Hegner on frog and toad tadpoles as sources of intestinal protozoa for teaching purposes During the last four years the writer has examined hundreds of tadpoles for intestinal protozoa, and is able to state that he has frequently found most of the species listed by Hegner in his paper, viz, *Trichomonas augusta, Hexamitus intestinalis, Nyctotherus cordiformis, Opalina ranarum, Endamoeba ranarum*, and *Euglenamorpha hegneri*, the latter an Euglena-like flagellate with three flagella *Giardia agilis* and *Balantidium entozoon* have never been observed by the writer *Euglena spirogyra, Phacus* sp ? and several species of desmids and diatoms, which are normally free-living forms, are often present in large numbers in the rectum of tadpoles, in which habitat they appear to be little the worse for any contact they may have had with the digestive juices of their host

In addition to the protozoa enumerated by Hegner several other species have been more or less frequently encountered These are *Chilomastix caulleryi* Alexeieff 1909, *Mastigina hylae* (Frenzel 1892) Goldschmidt 1907, and *Endolimax ranarum* Epstein and Ilowaisky 1914

Chilomastix caulleryi is a flagellate which lives in the rectum of the tadpoles of *Rana catesbiana* and *Rana clamata* It sometimes occurs, in large numbers, but is likely to be overlooked among the more numerous representatives of the species *Trichomonas augusta* Its morphology is practically identical with that of *Chilomastix mesnili* of man Its larger size makes it more favorable for study than the human form

Mastigina hylae is a large and extremely interesting protozoon which belongs to the flagellate family Rhizomastigidae Its most striking features are the prominent anterior nucleus and the constant active streaming of the protoplasm filled with remnants of the green algae and protozoa upon which it has fed The small anterior flagellum is inconspicuous and will be overlooked unless carefully searched for. The writer has never seen in any other cell protoplasmic streaming so vigorous and continuous as in this form For a more detailed description of this species the reader is referred to a paper by the writer in the

Journal of Parasitology for June, 1925. This protozoon has been found in tadpoles of *Rana catesbiana* and *R. clamata* in New Jersey and in those of *R. pipiens* in Iowa.

Endolimax ranarum is a smaller amoeba than *Endamoeba ranarum*, and is much less frequently encountered. Its nucleus is more or less typical of that of other members of the genus and careful staining is required to bring it out.

On the basis of the combined experiences of Dr. Hegner and those of the writer, we may confidently expect to find in our American tadpoles most of the following species of intestinal protozoa: (1) *Opalina ranarum*, (2) *Nyctotherus cordiformis*, (3) *Balantidium entozoon* (not observed by either Hegner or the writer), (4) *Giardi agilis*, (5) *Trichomonas augusta*, (6) *Chilomastix caulleryi*, (7) *Hexamitus intestinalis*, (8) *Euglenamorpha hegneri*, (9) *Mastigina hylae*, (10) *Endamoeba ranarum*, and (11) *Endolimax ranarum*. *Trichomonas batrachorum* and *Polymastix bufonis* are two other species which have been found in frogs and should be searched for in tadpoles. This formidable list of intestinal protozoa makes tadpoles invaluable for teachers in protozoology and invertebrate zoology.

The writer wishes also to call the attention of bacteriologists and microbiologists to a rather unusual bacterial flora which is sometimes encountered in the rectum of the tadpole. Large spirilla with a prominent spore at each end, bacilli of a crescentic shape with a prominent spore at each end, and other equally remarkable forms have been seen by the writer while making examinations of the contents of the rectum of tadpoles.

ELERY R. BECKER
IOWA STATE COLLEGE

THE EFFECT OF ULTRAVIOLET RADIATIONS UPON SOY BEANS

A SERIES of experiments was performed to study the effect of ultraviolet radiations upon the subsequent development of the soy bean. The full spectrum of an air-cooled quartz mercury lamp was used in every case. The plants were kept under rigidly controlled conditions.

The first outstanding result noted was that the longer the exposure the shorter the plant, that is, in successive experiments as the length of exposure was increased the internodes of the plant became shorter. The stems were very brittle and the leaf tissue very stiff and rigid.

The internal changes were equally interesting. The stems of irradiated plants were approximately one and one half times as large in diameter as the control plants. There was also a reduction of the number of medullary rays in irradiated plants, so that these plants tend to show that the meristematic tissues remain active for a very much longer period of time than in the control plants. The cells of the medullary rays under ordinary conditions remain parenchymatous but in irradiated plants have gone further and developed into xylem and phloem. Furthermore, because of differential growth the stems became hollow.

A detailed report of the work will be prepared later. The author wishes to express her appreciation to Dr. W. J. G. Land and Dr. C. A. Shull for their kind help and inspiration.

H. REBECCA DANE
UNIVERSITY OF CHICAGO

FLORA OF BARRO COLORADO ISLAND, CANAL ZONE

RECENTLY there appeared in SCIENCE an account of Barro Colorado Island.[1] Visiting scientists working upon plants are concerned with the names of the species to be found on the island. All such workers will be interested in a list of plants of Barro Colorado Island that has just been issued by the Smithsonian Institution. The author, Mr. Paul C. Standley,[2] who spent a week on the island, has traveled extensively in Central America and has published several articles on the flora of these regions. The flora is an annotated list without keys or complete descriptions, but the accompanying notes on common names, uses and prominent characters will be a great aid to those taking advantage of the facilities of the laboratory on the island.

Mr. Standley has also published a paper on the ferns of the island.[3] A flora of the Canal Zone by the same author is now in press.

The bibliography of papers relating to Barro Colorado Island now includes over 50 titles.

A. S. HITCHCOCK
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

A DAYLIGHT METEOR

AT a golf course on Warwick Neck, near Providence, Rhode Island, I was on a fairway overlooking Narragansett Bay about one o'clock in the afternoon of June 1, in brilliant sunlight when my companion and I distinctly saw what seemed to be a small meteorite dropping over the bay. It was fol-

[1] Kellogg, Vernon, "Barro Colorado Island Biological Station," SCIENCE 65: 535, 1927.

[2] Standley, Paul C., "The Flora of Barro Colorado Island, Panama," Smithsonian Miscellaneous Collections 78: No. 8, 1–32, 1927.

[3] Standley, Paul C., "The Ferns of Barro Colorado Island," *American Fern Journal* 16: 112–120, 1926; 17: 1–8, 1927.

lowed by a train of sparks much like a spent rocket, but originated too high to have been one From our position we could not see if it reached the water While it seemed to be only two or three miles away, I realized that such appearances are deceptive There was no sound accompanying the fall audible from where we stood

WILLIAM L BRYANT

PARK MUSEUM

QUOTATIONS

THE NATIONAL MUSEUM OF AUSTRALIAN ZOOLOGY

IN 1924 the Federal Parliament of Australia, knowing the fact that the unique native fauna of the commonwealth was fast disappearing, and recognizing its importance to medical science, founded the National Museum of Australian Zoology It was a wise and statesmanlike act, the full effect of which is only now beginning to be seen. Dr Colin Mackenzie was appointed director, with the title of professor of comparative anatomy It was a museum with a difference In the previous year Professor Mackenzie had presented to the commonwealth his specimens of living native animals, together with the buildings and fencing on the Research Reservation at Healesville He had given also his collection of macroscopic and microscopic specimens, numbering many thousands, and these now form the basis of the museum collection Each specimen has a direct application to some medical or surgical problem Nothing quite like the collection of normal histological preparations from reptiles, monotremes and marsupials, with which human or other mammalian tissue can be compared, exists anywhere in the world, and we are glad to know that illustrated atlases describing the collection are being prepared for publication—a huge enterprise which has been begun not a day too soon Early in 1923, when commenting on the announcement that the commonwealth government had passed an act to establish a Museum of Australian Zoology, we observed that there was clearly an obligation on Australia to preserve a full series of specimens, since the whole indigenous fauna of Australia seemed only too likely to follow Tasmanian man to extinction The commonwealth legislature has now gone rather further than we hoped, for it has not only allotted a site for the National Museum of Australian Zoology at Canberra, the new capital of Australia, but the Federal Capital Commission has provided a site for a zoological park or reservation, in which will be kept living specimens of Australian and Tasmanian native animals in their natural state. The area of the site for the museum, laboratories and lecture theater is about five and a half acres, in a magnificent situation on Action Hill, facing Parliament House The research reservation or zoological park, containing about eighty acres, is on a peninsula bounded on two sides by the river Molonglo. The report of the Parliamentary Standing Committee on Public Works, dealing with the construction of buildings, has now been published, authorizing for this purpose a sum approximating £100,000 The report has received the unanimous approval of the Federal Parliament, and the buildings, representing what is really the first stage in the establishment of the National University of Australia, will be begun immediately When the buildings are completed every facility will be offered to workers—not only Australian, but also from other countries—wishing to study comparative anatomy and its application to modern medical and surgical practice. The museum is now at Melbourne, but is to be moved to Canberra next year. To its original contents many important additions have recently been made, including the collection of specimens valued at £25,000 belonging to Dr. George Horne, of Melbourne, dealing with the Stone Age men of Australia, and also a collection of aboriginal skulls made by Dr Arthur Nankivell, of Kerang The museum also possesses the Froggatt entomological collection, and that of Mr Murray Black dealing with the aborigines of South-East Victoria. The completely fossilized prehistoric Cohuna skull, together with many other specimens of anthropological value, belong to the museum The federal government of Australia is to be congratulated on its decision to establish a center for the advancement of comparative anatomy, which admittedly is the foundation of all the medical sciences We may venture to express the hope that the lead now given by Professor Colin Mackenzie will encourage wealthy Australians to display a similar national spirit, and by liberal endowments help on the necessary research work in the interests of humanity.—*The British Medical Journal*

SCIENTIFIC BOOKS

The Internal Constitution of the Stars By A S EDDINGTON, M.A , F R S , Cambridge; at the University Press, 1926. 407 pp , 5 figures

THE fundamental problem in astrophysics may be regarded as the construction of models which, obeying the well-established laws of theoretical physics, describe the observed intrinsic properties of the stars Thus there are stellar models which describe the formation of the observed spectra in reversing layer and chromosphere, models which describe the formation of binary stars by fission and the behavior of cepheid

variables and finally models which lead to relations between the mass, radius, luminosity and effective temperature of a star Such stellar models, both as regards their field of usefulness in scientific thought as well as their frequent incompatibility with one another, are closely analogous to the various atomic models designed to describe the properties of matter In astronomy, as well as in atomic physics, the value of a given model depends upon the range of facts *quantitatively* described, upon its powers of prediction and upon the small number of special postulates built into the model

It is now some ten years since the appearance of Eddington's first paper on the interior of a star The general theory therein developed and the model adopted furnished a successful description of the stars as then known The development by Kramers, from the correspondence principle, of an expression for the mass coefficient of absorption permitted Eddington in 1924 greatly to improve his model and to predict the mass-luminosity relation This prediction and its verification have profoundly modified astronomical conceptions of stellar evolution At the same time, Eddington's theory has reacted upon modern atomic physics and has inspired numerous important investigations on the physics of matter at high temperatures, notably the work of Eggert (which led to Saha's important theory) and the recent investigations of R H Fowler Astronomers and physicists both, then, will welcome the present volume in which Eddington gives a systematic development of the whole theory

The general treatment may be outlined in the following manner Given a mass of gas under its own gravitational attraction, the internal distribution of density, pressure and temperature may be derived from the equation of state of the gas and the requirements of mechanical and thermal equilibrium The condition of mechanical equilibrium requires that the total pressure (gas pressure + radiation pressure) at any internal point balances the weight of the overlying layers, and is expressed by the well-known differential equation of hydrostatics The condition of thermal equilibrium requires that the flow of heat does not disturb the internal distribution of temperature, but to formulate the differential equation it is necessary to know the mode of heat transfer Schwarzschild has shown that this transfer in the outer layers of the sun is by radiation rather than convection, and Eddington has shown that convection currents can in fact be only maintained at the expense of their own mechanical energy and so must die out Granting that heat transfer is by radiation, the well-known differential equation of radiative equilibrium may be derived from elementary considerations, and this equation, Eddington has shown, is accurate to a high order of approximation

To integrate these differential equations, it is now necessary to make certain assumptions, or in other words to adopt a definite stellar model Eddington assumes that the star consists of a perfect gas of constant molecular weight in which the product ηk is invariable throughout the interior Here η is the ratio of the average liberation of energy per gram within any sphere of radius r to the average liberation of energy per gram in the whole star, and k is the mass-coefficient of absorption On this model and without difficult quadratures it is possible to arrive at two important results—firstly, that the ratio of radiation pressure to gas pressure throughout the star is constant and a function of the stellar mass, and, secondly, that *for stars of the same mass the luminosity varies inversely as* ηk A detailed solution by quadratures, integrating from within outwards, as carried through first by Emden, gives the internal distribution of density, pressure and temperature, but involves as an unknown constant the mean molecular weight. The mean molecular weight of course depends upon the degree of ionization in the interior, which in turn depends upon the temperature and pressure A solution by trial and error indicates a molecular weight of 2 1 which is adopted for subsequent work Accordingly when the model star is of the same mass and radius as our sun, its central density turns out to be 76 gms per cu cm and its central temperature forty million degrees Finally, Kramers' law of absorption is introduced, and this, by virtue of the constant proportionality throughout the model of the density to the cube of the temperature, reduces to the form that the absorption coefficient varies inversely as the square root of the temperature Introducing this result into the relation italicized above, the mass luminosity relation is reached—

$$\log(\text{Luminosity}) = \frac{7}{5}\log(\text{Mass})$$

$$+\frac{8}{2}\log\frac{\text{radiation pressure}}{\text{total pressure}}+\frac{4}{5}\log(\text{Surface temperature})$$

$$+\text{Constant}$$

absorption law), and this is fixed from the mass, luminosity and effective temperature of a single star (Capella) It is then found that all thirty-seven stars of known mass and luminosity, both giants and dwarfs, lie on Eddington's mass-luminosity curve

Of the several quantitative predictions furnished by Eddington's model, none is more striking or more general than this relation that the luminosity of a star, apart from a small factor depending upon the surface temperature, is a single-valued function of its mass The relation contains but one disposable constant (the proportionality constant of Kramers'

with an average residual of the order of half a magnitude It is at first sight paradoxical that a "perfect gas" model should accurately predict the luminosity of dwarf stars with a mean density as high as that of copper The paradox is, however, removed if Eddington's model be regarded as giving an acceptable picture of the actual interior of a star In that event we must regard the stellar interior as being highly ionized so that the stellar "molecules" (i e electrons and atoms ionized down to the K shell) have but one millionth the volume of terrestrial molecules The equation of state for a perfect gas will therefore be applicable in the actual stellar interior at mean densities comparable with that of platinum Moreover, we may qualitatively predict the possible existence of stars with mean densities for in excess of terrestrial experience—a prediction recently verified by the "white dwarfs" of which one, the companion of Sirius, has a mean density of sixty-one thousand grams per cubic centimeter Quantitatively and qualitatively a veritable triumph for the Eddington model!

The model, as so far detailed, predicts that for stars of the same mass any surface temperature or spectral type is equally probable The facts are, however, that the stars fall into a Russell diagram which must now be described as a reversed figure Z consisting of three branches—the giant, main sequence and white dwarf branch Along the main sequence, which contains by far the greatest number of stars, there is a very definite relation between spectral type, on the one hand, and mass, or equivalent luminosity, on the other Eddington's model will only obey a relation of this kind if the liberation of energy per gram rapidly decreases from star to star down the main sequence. We are, therefore, forced to postulate an unknown source of energy, and one of the most interesting and stimulating chapters in the book under review is concerned with a very full discussion of the nature of this source and the cause of its variation. A survey of the possible sources, from the viewpoint of the time-scale demanded by both geologists and astronomers, indicates that some form of subatomic energy is required The difficulty on Eddington's model, however, is that the temperatures which stimulate and control this subatomic source are absurdly low It would seem as if the only subatomic source compatible both with contemporary physics and Eddington's model is C T R Wilson's "runaway electron," a not very encouraging prospect A question of interest to the astronomer is whether the source or sources form a large fraction of the mass of the star. It is only in this event that any important evolution, which can only result from a loss of mass, is possible in the life history of the star. Quite apart from any stellar model, and accepting the mass-luminosity law as a purely empirical relation, Trumpler's recent observations of the coexistence in open, and presumably old, clusters of massive stars of types B, F, G, coeval with ordinary dwarfs of types F and G, seem to preclude the possibility of such evolution in these clusters Eddington says, "it seems almost necessary to throw over the idea of any important advance in evolution in the life-time of the clusters, and it then becomes a question whether there is any point in retaining the idea for stars in general"—a statement which should commend itself to the conservative astronomer

The general plan of the book, which discusses these and many other problems, is firstly to lay the foundations of thermodynamics and the quantum theory and then to proceed step by step in, roughly speaking, an historical order, through the whole theory In this way are discussed in successive chapters Emden's quadratures of the differential equations for various polytropes, the derivation of the equation of radiative equilibrium, the solution of the equations with a detailed justification of the various assumptions included in the model, the mass-luminosity law and the problem of Cepheid and other variable stars Chapter IX deals with the coefficient of opacity, and here Eddington's model encounters its second principal difficulty, the other difficulty, of course, having to do with sources of energy Kramers' theory gives the following expression for the mass coefficient of absorption

$$\log (K) = \log (\text{Density}) - \log (\text{Molecular Weight}) - \frac{7}{2} \log (\text{Temperature}) + \text{Constant}$$

The numerical value of the constant is predicted by theory and satisfactorily verified by laboratory experiments with X-rays This is the same constant, however, which was disposable in Eddington's model, and for which an astronomical value was obtained The astronomical value exceeds the theoretical one, verified by terrestrial experiment, by a factor of ten Eddington's thorough discussion of the whole problem reveals no adequate explanation of this discrepancy. Subsequent chapters discuss ionization and diffusion in the star, sources of energy, models for the outside of the star (largely due to Milne) and finally diffuse matter in space Special mention should be made of the treatment of diffusion and von Zeipel's general theorem on a rotating star If these theories which are applicable to all models can be successfully defended they rule out of court models, such as those recently proposed by Jeans, in which there is a concentration towards the stellar center of the heavier elements

The book is written with Eddington's characteris-

tic clarity and abounds in happy and stimulating allusions. It can not fail to suggest to every serious reader numerous subjects for further observational and theoretical investigation In future editions the value of the book would be enhanced for the reviewer, and possibly also for other observational astronomers of slender mathematical attainments, by the interpolation of a chapter between III and IV giving a brief and as nearly as possible self-contained mathematical development of the whole theory Reference could then be made forward from this chapter to the subsequent chapters, which would retain much their present form, for a detailed discussion of the various assumptions, for the quadrature of the differential equations, for the discussion of the opacity law and so on. I do not believe that such an interpolation would seriously interfere with the logical treatment of the theory, and it is conceivable that it might eliminate some of the many cross references, forwards and backwards, which are essential with the present arrangement.

H H. Plaskett
Dominion Astrophysical Observatory,
Victoria, B C

ARTIFICIAL TRANSMUTATION OF THE GENE

Most modern geneticists will agree that gene mutations form the chief basis of organic evolution, and therefore of most of the complexities of living things. Unfortunately for the geneticists, however, the study of these mutations, and, through them, of the genes themselves, has heretofore been very seriously hampered by the extreme infrequency of their occurrence under ordinary conditions, and by the general unsuccessfulness of attempts to modify decidedly, and in a sure and detectable way, this sluggish "natural" mutation rate Modification of the innate nature of organisms, for more directly utilitarian purposes, has of course been subject to these same restrictions, and the practical breeder has hence been compelled to remain content with the mere making of recombinations of the material already at hand, providentially supplemented, on rare and isolated occasions, by an unexpected mutational windfall. To these circumstances are due the wide-spread desire on the part of biologists to gain some measure of control over the hereditary changes within the genes.

It has been repeatedly reported that germinal changes, presumably mutational, could be induced by X or radium rays, but, as in the case of the similar published claims involving other agents (alcohol, lead, antibodies, etc), the work has been done in such a way that the meaning of the data, as analyzed from a modern genetic standpoint, has been highly disputatious at best, moreover, what were apparently the clearest cases have given negative or contrary results on repetition Nevertheless, on theoretical grounds, it has appeared to the present writer that radiations of short wave length should be especially promising for the production of mutational changes, and for this and other reasons a series of experiments concerned with this problem has been undertaken during the past year on the fruit fly, *Drosophila melanogaster*, in an attempt to provide critical data. The well-known favorableness of this species for genetic study, and the special methods evolved during the writer's eight years' intensive work on its mutation rate (including the work on temperature, to be referred to later), have finally made possible the finding of some decisive effects, consequent upon the application of X-rays The effects here referred to are truly mutational, and not to be confused with the well-known effects of X-rays upon the distribution of the chromatin, expressed by non-disjunction, non-inherited crossover modifications, etc In the present condensed digest of the work, only the broad facts and conclusions therefrom, and some of the problems raised, can be presented, without any details of the genetic methods employed, or of the individual results obtained.

It has been found quite conclusively that treatment of the sperm with relatively heavy doses of X-rays induces the occurrence of true "gene mutations" in a high proportion of the treated germ cells. Several hundred mutants have been obtained in this way in a short time and considerably more than a hundred of the mutant genes have been followed through three, four or more generations. They are (nearly all of them, at any rate) stable in their inheritance, and most of them behave in the manner typical of the Mendelian chromosomal mutant genes found in organisms generally. The nature of the crosses was such as to be much more favorable for the detection of mutations in the X-chromosomes than in the other chromosomes, so that most of the mutant genes dealt with were sex-linked; there was, however, ample proof that mutations were occurring similarly throughout the chromatin When the heaviest treatment was given to the sperm, about a seventh of the offspring that hatched from them and bred contained individually detectable mutations in their treated X-chromosome. Since the X forms about one fourth of the haploid chromatin, then, if we assume an equal rate of mutation in all the chromosomes (per unit of their length), it follows that almost "every other one" of the sperm cells capable of producing a fertile adult contained an "individually detectable" mutation in some chromosome or other Thousands of untreated parent flies were bred as controls in the same way as the treated

ported, several different dosages were made use of, and while the figures are not yet quite conclusive they make it probable that, within the limits used, the number of recessive lethals does not vary directly with the X-ray energy absorbed, but more nearly with the square root of the latter Should this lack of exact proportionality be confirmed, then, as Dr Irving Langmuir has pointed out to me, we should have to conclude that these mutations are not caused directly by single quanta of X-ray energy that happen to be absorbed at some critical spot If the transmuting effect were thus relatively indirect there would be a greater likelihood of its being influenceable by other physico-chemical agencies as well, but our problems would tend to become more complicated There is, however, some danger in using the total of lethal mutations produced by X-rays as an index of gene mutations occurring in single loci, for some lethals, involving changes in crossover frequency, are probably associated with rearrangements of chromosome regions, and such changes would be much less likely than "point mutations" to depend on single quanta A reexamination of the effect of different dosages must therefore be carried out, in which the different types of mutations are clearly distinguished from one another When this question is settled, for a wide range of dosages and developmental stages, we shall also be in a position to decide whether or not the minute amounts of gamma radiation present in nature cause the ordinary mutations which occur in wild and in cultivated organisms in the absence of artificially administered X-ray treatment.

As a beginning in the study of the effect of varying other conditions, upon the frequency of the mutations produced by X-rays, a comparison has been made between the mutation frequencies following the raying of sperm in the male and in the female receptacles, and from germ cells that were in different portions of the male genital system at the time of raying. No decisive differences have been observed It is found, in addition, that aging the sperm after treatment, before fertilization, causes no noticeable alteration in the frequency of detectable mutations. Therefore the death rate of the mutant sperm is no higher than that of the unaffected ones; moreover, the mutations can not be regarded as secondary effects of any semi-lethal physiological changes which might be supposed to have occurred more intensely in some ("more highly susceptible") spermatozoa than in others.

Despite the "negative results" just mentioned, however, it is already certain that differences in X-ray influences, by themselves, are not sufficient to account for all variations in mutation frequency, for the present X-ray work comes on the heels of the determination of mutation rate being dependant upon temperature (work as yet unpublished). This relation had first been made probable by work of Altenburg and the writer in 1918, but was not finally established until the completion of some experiments in 1926. These gave the first definite evidence that gene mutation may be to any extent controllable, but the magnitude of the heat effect, being similar to that found for chemical reactions in general, is too small, in connection with the almost imperceptible "natural" mutation rate, for it, by itself, to provide a powerful tool in the mutation study The result, however, is enough to indicate that various factors besides X-rays probably do affect the composition of the gene, and that the measurement of their effects, at least when in combination with X-rays, will be practicable Thus we may hope that problems of the composition and behavior of the gene can shortly be approached from various new angles, and new handles found for their investigation, so that it will be legitimate to speak of the subject of "gene physiology," at least, if not of gene physics and chemistry.

In conclusion, the attention of those working along classical genetic lines may be drawn to the opportunity, afforded them by the use of X-rays, of creating in their chosen organisms a series of artificial races for use in the study of genetic and "phaenogenetic" phenomena If, as seems likely on general considerations, the effect is common to most organisms, it should be possible to produce, "to order," enough mutations to furnish respectable genetic maps, in their selected species, and, by the use of the mapped genes, to analyze the aberrant chromosome phenomena simultaneously obtained Similarly, for the practical breeder, it is hoped that the method will ultimately prove useful. The time is not ripe to discuss here such possibilities with reference to the human species

The writer takes pleasure in acknowledging his sincere appreciation of the cooperation of Dr. Dalton Richardson, Roentgenologist, of Austin, Texas, in the work of administering the X-ray treatments.

H. J MULLER

UNIVERSITY OF TEXAS

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN INSTRUMENT FOR REPEATED DETERMINATIONS OF BLOOD VISCOSITY IN AN ANIMAL[1]

IN experiments where it is desirable to make repeated determinations of the viscosity of the blood of an animal, the withdrawal of the amount of blood

[1] From the Physiological Laboratories of the University of Chicago and the University of Western Ontario, London, Canada.

for the determinations and its replacement by fluid of less viscosity from the tissues causes a progressive diminution in the viscosity of the blood

In order to make viscosity determinations without withdrawal of blood from the animal, the instrument to be described here was constructed

DESCRIPTION OF THE INSTRUMENT

Figure (1) shows a semi-diagrammatic representation of the instrument, "A" is a glass bulb of approximately 10 c c capacity and is clamped between two metal plates "B" and "C" by means of rods "D" and "D_1" Two rubber washers "E" and "E_1" placed between the ends of the glass bulb and the metal plates insure a tight joint Leading from the lower end of the bulb through the metal plate "B" are two openings, the one leading into an arterial cannula "F" and the other into a glass tube "G" of fine capillary bore and shaped at the free end to facilitate tieing into a vein A hole continuous with that of the upper end of the bulb passes through the upper plate Above the upper plate "C" is a similar plate "H" held in place by a central screw and capable of being rotated upon plate "C" The movable plate has two openings "I" and "J", by rotating the movable plate on the stationary one, one or the other of the openings is placed over the hole in the stationary plate leading into the upper end of the glass bulb. One of the openings in the movable plate is connected to a rubber tube through which a definite pressure equal to that in the arterioles of the animal can be applied. The pressure is supplied from the air line and regulated by means of a mercury valve. The other opening in the movable plate is fitted with a release valve "K" with spring "K_1" so that air may be allowed to escape from the bulb as it is being filled with blood; a small handle "O" is fastened to the moving plate to facilitate rotating it in bringing either opening over the upper end of the glass bulb A rod "L" to clamp the instrument in place is attached to the upper stationary plate and from this a support "M" passes down to the capillary tube "G" An insulated terminal "N" with a projecting arm is attached to the supporting rod, so that a platinum point on the end of the arm just comes in contact with a similar point on the handle of the rotating plate when the hole connected with the air line is directly over the upper opening of the glass bulb This insulated terminal and the frame of the instrument is connected in series with a dry cell and a signal magnet A time clock is made to write on the drum above the signal magnet

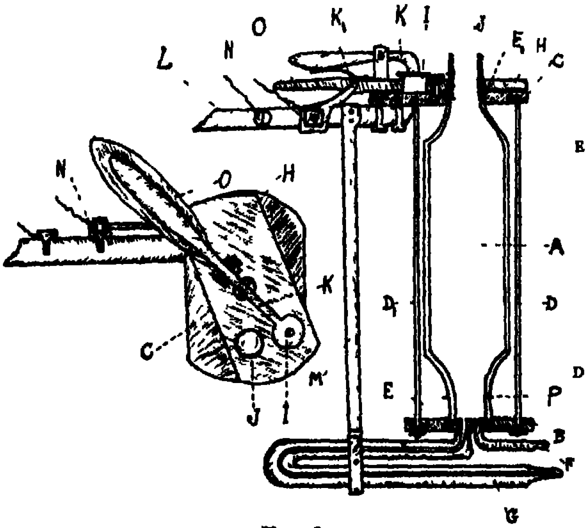

FIG 1

METHOD OF USE

After anesthetizing the animal and injecting sufficient heparin to make the blood incoagulable, the carotid artery and external jugular vein are exposed. The arterial cannula is then inserted into the artery on which a bull dog is placed and the vein prepared for insertion of the capillary tube. After opening the release valve "K" and having the revolving plate in position so that this opening is directly over the upper end of the glass bulb, the bull dog is removed from the artery and the blood allowed to displace the air in the bulb upward until the latter is completely filled with blood, the release valve is then closed With the blood filling the glass bulb and the capillary tube, the free end of the latter is tied into the external jugular vein The pressure with which the blood enters the bulb "A" is sufficient to insure its circulation in all parts of the bulb, after which it returns to the external jugular vein by way of the capillary tube "G" A determination may now be taken at any time

Viscosity determinations are carried out as follows The bull dog is first replaced on the artery and then the movable plate is quickly rotated by means of the handle "O" until the tube carrying the air pressure is directly over the upper opening in the glass bulb, thus a pressure equal to that in the arterioles is exerted upon the blood and it is forced out of the bulb into the venous side of the circulation. When the blood reaches the mark "P" on the lower neck of the bulb, the rotating plate is quickly moved back to its former position, the release valve "K" is opened and the clamp again removed from the artery. This allows the bulb to again fill with blood and the latter to circulate through the instrument. During the time the blood is being driven out of the bulb by means of air pressure, the arm of the

insulated terminal "N" is in contact with the metal handle of the movable plate; this makes an electrical contact and the signal magnet records the time taken for the blood to be driven through the capillary tube under a known pressure This time when compared with that required for water under the same pressure gives the relative viscosity of the blood

It is evident that any number of determinations may be taken without decreasing the amount of blood in the animal The electrical recording of the time is of advantage in reducing the error due to the reaction time of the experimenter Because of the short time the blood for determinations remains in the bulb, a bath for temperature control is not thought necessary

In order to test the accuracy of the instrument, a series of experiments was carried out in which the relative viscosity of 7 per cent gum arabic was determined by means of this instrument and the same procedure carried out with the Oswald viscosity pipette, water being taken as unity, in thirty determinations with each instrument it was found that the relative viscosity of the gum solution when determined with this instrument was 3 76 while with the Oswald type it was 3 78 These results appear to be well within the range of experimental error The determinations were made at room temperature and the pressure on the fluid maintained at 70 mm Hg

The author is indebted to Professor A J Carlson for his helpful suggestions and criticisms of this work and to Mr F W Claassens for his cooperation in construction of the instrument.

RUSSELL A WAUD

SPECIAL ARTICLES

BALANTIDIA FROM PIGS AND GUINEA-PIGS THEIR VIABILITY, CYST PRODUCTION AND CULTIVATION

THE following data concerning *Balantidium* occurring in the pig and guinea-pig are deemed of sufficient importance to warrant a report at this time An abundance of material from the pig has been obtained from two packing plants within several squares of the laboratory, and Dr W R. Stokes, of the Baltimore City Health Department, has kindly furnished guinea-pigs for autopsy that died as a result of experimental work Thus far of the twenty examined, 55 per cent were infected with *Balantidium*. A colony of rhesus monkeys which also harbor *Balantidium* is maintained by Dr. Carl Hartman, of the Carnegie Institution. This article is a progress report on a problem of host-parasite relations which was suggested to me by Dr. R. W. Hegner.

VIABILITY

According to McDonald[1] (1922) the trophozoites of *Balantidium* of the pig become spherical when the intestinal contents are cooled to room temperature. McDonald also states that they live at room temperature not longer than eight hours Accordingly, a thermos bottle was used to carry the material to the laboratory from the packing plant No appreciable rounding was noted when the organisms were examined at room temperature Therefore, the content of a bottle obtained January 3, 1927, was allowed to cool. Active, apparently normal, trophozoites were found in a sample taken from this bottle the next morning and on every subsequent morning until January 14 The relative numbers did not appear to diminish for about seven days, but then fell off very rapidly The temperature of the contents of the bottle was taken after fourteen hours, and found to be 20° C On several other occasions the organisms lived at room temperature for four days and on one occasion for seven days The viability of trophozoites is also indicated by the fact that water from the trucks in which the pigs were transported from the cars was found to contain them, they remained perfectly normal in appearance at room temperature for twenty-four hours Feces passed at least two hours previously by ten different pigs were collected from the pens at the packing plant Trophozoites were found in seven of the ten samples The pigs had been long in transit from Ohio and the feces were well formed so that they had to be torn apart in water before the trophozoites were freed. The latter appeared perfectly normal and swam about actively

INFECTIVITY OF TROPHOZOITES

It seems to be the general opinion that ingestion of cysts must occur to set up an infection (Fantham, Stephens and Theobald,[2] 1916), but Hegner[3] (1926) injected trophozoites from the pig into the stomach of the guinea-pig, and, when the animal was killed one hour later, active, apparently normal trophozoites were found in the stomach, small intestine and cecum This experiment has been repeated with success

[1] McDonald, J D 1922 "On *Balantidium coli* (Malmsten) and *Balantidium suis* (sp nov) with an Account of their Neuromotor Apparatus Univ Calif. Pub. Zool., 20 243–300

[2] Fantham, H B, Stephens, M. D, and Theobald, M A 1916. "The Animal Parasites of Man," 900 pp New York

[3] Hegner, R. W 1927 "Host Parasite Relations between Man and His Intestinal Protozoa." The Century Co, New York (In press)

Trophozoites of the pig *Balantidium*, grown in culture, were injected into the stomach of a guinea-pig four weeks old It died during the night, but after eighteen hours trophozoites, gorged with starch grains, were found in the esophagus and cecum. That these were not inhabitants of the intestine before the experiment began is indicated by the fact that the latter are always translucent and move slowly, whereas those from cultures are blackened from ingested starch and move actively Later another guinea-pig from the same litter was given trophozoites by stomach tube direct from the pig This animal also died during the night and trophozoites were found the next morning in the ileum, jejunum and cecum They were of two kinds in the cecum, (1) those that parasitize the guinea-pig and (2) the starch-filled forms of the pig When it is considered that trophozoites may live in feces for ten days at room temperature it is probable that they may serve as well as cysts in transmitting infection

Cyst Production in the Pig

McDonald (1922) states that trophozoites were in various stages of encystment in the lower colon and rectum of the pig and all encysted in the formed feces In Baltimore during February and March no cysts were found until about thirty pigs, all of which were infected with *Balantidium*, had been examined They were not numerous, about three hours were required to pick out twenty specimens Because of their large size, cysts of *Balantidium* can be distinguished with a binocular microscope Material can be diluted in a Syracuse watch glass and examined much more rapidly than when slides are used Cysts can be picked out with a micropipette and studied under the compound microscope In this work, as well as by McDonald (1922), the cysts were found to be very resistant to fixing and staining. The nucleus and other structures are not revealed when they are treated with iodine eosine or even when Mallory's haematoxylin is run under the cover glass after fixation with Schaudinn's fluid When bodies resembling cysts were finally found the material was treated in bulk with hot Schaudinn's and stained with iron haematoxylin (method of Kofoid and Swezy) They were then picked out and positively identified Walker[4] (1913) and others state that fecal diagnosis for *Balantidium* in man and monkeys is unsatisfactory, because for long periods no cysts are passed Walker (1913) states, as does McDonald (1922), that cysts are frequent in feces of pigs. Walker and others express the opinion that for this reason infection in man is usually contracted from pigs. Data obtained in Baltimore, however, indicate that cysts may be as scanty in pigs as in man, monkeys and guinea-pigs.

Cultivation

Much experimental work has been done recently and is being continued on cultivating parasitic protozoa The first media tried by myself were made according to directions given by Dobell and Laidlaw[5] (1926) for *Endamoeba histolytica* On one occasion trophozoites lived seventy-two hours and multiplied. The medium consisted of an inspissated human serum slant plus a fluid of Ringer's solution without dextrose, nine parts, and human serum, one part Sterile rice starch was added. Transplants from this culture failed Various egg media were tried with negative results Walker (1913) concluded, as a result of experiments, that a 0 5 per cent. NaCl solution is best suited for *Balantidium* Barret and Yarbrough[6] (1921) cultivated *Balantidium coli* successfully in a medium 0 5 per cent NaCl, fifteen parts, plus human serum, one part Their cultures were maintained thirty-two days In order to ascertain whether Walker's data could be applied in the cultivation of *Balantidium* from the pig the concentration of the medium in which the organism lives was determined Feces from the cecum were filtered through filter paper and the freezing point method employed, with a Beckmann thermometer The reading of filtrate from fresh feces was minus 0 70° C , of filtrate from feces kept forty-eight hours in the laboratory minus 0.79° C , and of feces kept 168 hours it was minus 0 72° C. The freezing point of blood serum is about minus 0 6° C , and is isotonic with an 0 85 per cent. NaCl solution Walker found this hypertonic for *Balantidium*, and preliminary trials carried out here seemed to confirm this conclusion Hence it was thought that the hypertonicity of 0 85 per cent. NaCl is due to an excess of inorganic ions Accordingly, 10 cc of each of the above fecal filtrates were evaporated to dryness, and the organic matter driven off by heating The residue was taken up in 10 cc of distilled water and the freezing point found to be minus 0 17° C. This is isotonic with a NaCl solution of about 0 25 per cent On the basis of the above data an attempt was made to prepare synthetic media,

[4] Walker, E L 1913. "Quantitative Determination of the Balantidicidal Activity of Certain Drugs and Chemicals as a Basis for Treatment of Infections with *Balantidium coli*." *Philippine Journ. Sci.* (B), 8 1–15.

[5] Dobell, C., and Laidlaw, P. P 1926 "On the Cultivation of *Endamoeba histolytica* and Some Other Entozoic Amoebae " *Parasit*, 18: 283–318

[6] Barret, H. P., and Yarbrough, N. 1921. "A Method for Cultivation of *Balantidium coli*," *Amer Journ. Trop. Med.*, 1: 161.

using 0.25 per cent. NaCl solution and adding urea in one instance and aminoids, Biuret free, in another, to make the solution about isotonic with blood serum Blood serum and starch were also added to some of the tubes. The results of culture experiments were invariably negative in the urea tubes Growth was occasionally noted in the aminoids, but transplants were unsuccessful.

Successful results were finally secured by using the method of Barret and Yarbrough (1921) with a modified Ringer's solution instead of 0.5 per cent. NaCl. The latter contained · NaCl 6 5 gms, KCl 0 14 gms, $CaCl_2$ 0 12 gms, $NaHCO_3$ 0 20 gms., Na_2HPO_4 0 01 gms, per liter of distilled water The ingredients were weighed from C P crystals on an analytical balance but no attempt was made to desiccate them before weighing The freezing points of various solutions thus far used have ranged from minus 0 52° C to minus 0 58° C Eighteen cc is pipetted into clean test tubes and autoclaved Two cc of human or horse serum is then added, plus a sprinkle of sterile rice starch Pig serum has thus far proved unsatisfactory A solution made from Loeffler's dehydrated blood serum is used frequently instead of the human or horse serum This product is manufactured by the Digestive Ferments Company, of Detroit, Mich The contents are listed as beef blood 3 parts and dextrose broth 1 part Solution is obtained by adding 8 gms. of the powder to 100 cc of distilled water at 40° C It is advantageous to measure the water in a 250 cc flask containing a few glass beads and sterilize Shaking the flask with the beads aids in securing solution, but even so there is much suspended matter A culture of *Balantidium* from the pig was maintained for fifty-four days and was still thriving on April 4 The tubes are kept in an incubator at 36° C and transplants are made according to Barret and Yarbrough's technique Twenty transplants have been made They are made usually at three-day intervals, but on one occasion (7th transplant), a seven-day interval occurred Trophozoites in abundance have been found on a number of occasions at the end of seven days, but they usually decrease rapidly after three days

Twelve attempts have been made to secure pure lines by isolating single individuals The findings agree with those of Barret and Yarbrough that this can not be done by the drop culture method The organisms appear to be anaerobic. Success was obtained by picking out single individuals with a micropipette, placing into a drop of culture fluid on a cover slip and dropping the latter into a test tube containing the medium On one occasion multiplication occurred but the transplant failed.

After three unsuccessful attempts a culture was started with *Balantidium* from the guinea-pig in the same media as are used for the culture from the pig. This strain has now been successfully transplanted six times The organisms ingest starch as does the pig *Balantidium* and become very active. It would be impossible to distinguish the trophozoites from those from the pig if the labels were left off the culture tubes. Occasional cysts have been found in tubes in which trophozoites from the guinea-pig have disappeared Despite repeated research no cysts have been found in cultures from the pig

RESISTANCE OF TROPHOZOITES TO HYDROGEN SULPHIDE

The odor of H_2S is always pronounced in the feces of pigs On five occasions this gas has been bubbled through culture tubes for fifteen to thirty seconds. No deleterious effects have been noted on the trophozoites The first time that the experiment was tried the culture from the pig lived seven days. It was hoped that this gas might be used to check the growth of harmful bacteria Subsequent results were so variable that no conclusions are justified H_2S was found toxic to the trophozoites when bubbled through feces of the pig, when treated and untreated samples were kept in the incubator the organisms disappeared in forty-eight hours from the treated tubes but lived seventy-two hours in the untreated material.

SUMMARY

It has been shown that trophozoites of balantidia from the pig are normal in appearance and reactions when the medium is cooled to room temperature They may live at room temperature for ten days. Trophozoites that infect the pig may pass through the stomach of the guinea-pig and reach the cecum, where they are normal after eighteen hours Trophozoites are frequently passed in feces by the pig but cyst production is irregular and determined by unknown factors as in monkeys, guinea-pigs and man. The fluid of pig feces from the cecum is slightly hypertonic to blood serum. The method of Barret and Yarbrough for the cultivation of *Balantidium coli* has been found practicable for *Balantidium* from the pig and guinea-pig. The addition of rice starch improves the medium and Ringer's solution without dextrose was found more suitable than 0 5 per cent. NaCl solution Loeffler's beef blood serum may be substituted for human serum or horse serum. H_2S appears non-toxic to *Balantidium* from the pig when passed into culture tubes

C. W. REES

THE JOHNS HOPKINS SCHOOL OF HYGIENE AND PUBLIC HEALTH

THE DECOMPOSITION OF HYDROGEN PEROXIDE AND THE MECHANISM OF LATENT PHOTOGRAPHIC IMAGE INTENSIFICATION[1]

IN a previous paper[2] some interesting experimental facts concerning the effect which was called the intensification of latent image by H_2O_2 and some other substances were presented This phenomenon consists of an increased developability above the normal of the exposed portions of a plate treated after exposure with H_2O_2

The object of the present work was to find the reason for the intensification of latent image. In the course of it, certain possible underlying mechanisms suggested themselves

It was the work of Bray and Livingston[3] on the catalytic decomposition of H_2O_2 in solutions containing H and Br ions which gave the first possible clue as to such a mechanism. They showed that prior to a steady state, which may require an hour or more in being reached, the following reactions take place when acid and soluble bromide are mixed with H_2O_2 solution

$$H_2O_2 + 2\ Br^- + 2\ H^+ = Br_2 + 2\ H_2O \qquad (1)$$

$$H_2O_2 + Br_2 = O_2 + 2\ Br^- + 2\ H^+ \qquad (2)$$

The sum of these, or the steady state gives

$$2\ H_2O_2 = 2\ H_2O + O_2 \qquad (3)$$

Soluble bromide is present in practically all ordinary dry plates, and in all the previous work on latent image intensification acid was present in the solution of H_2O_2 used

The second possible clue to an explanation of the action was a chemical mechanism of latent image formation recently proposed by K C D Hickman[4] He has obtained evidence that while in bulk, in a test tube, Br in water solution reacts quantitatively with Ag_2S to give AgBr, H_2SO_4 and HBr, in the photographic plate on the other hand, when the Ag_2S is isolated in the so-called sensitivity specks[5] and the Br is formed only in very limited quantity, by the photochemical decomposition of AgBr grains, then certain reactions take place which he believes give rise to metallic Ag instead of AgBr. He further believes, as we do also, that it requires a smaller speck of Ag than of Ag_2S to produce developability of the grain and he gives some evidence in support of this contention

We have found that when H_2O_2 solution is added to a suspension of Ag_2S in a solution of acid and soluble bromide that some of the sulfur of the sulfide is oxidized to H_2SO_4 and, in a bulk reaction such as this, AgBr is formed When no soluble bromide is present, however, the Ag_2S apparently remains unattacked

Taking the previous facts into consideration and assuming that Hickman is correct in his contention, it seems reasonable to suppose that when the photographic plate is treated with acid H_2O_2 the trace of bromide formed from the soluble bromide in the plate attacks the silver sulfide of the sensitivity or latent image speck (where it has not all been transformed into silver during the light exposure) and thus renders the grain developable

The fact that acid H_2O_2 converts metallic Ag to Ag ions should not alter this hypothesis since Ag ions, when adsorbed to AgBr, are at least as effective as metallic silver, if not more so, in producing developability of the grain

W Clark has contended[6] that the action of H_2O_2 in producing latent fog on a photographic plate is purely chemical and not one of chemiluminescence as previously supposed by Sheppard and one of us[7] The present hypothesis and experimental work, while they do not disprove the chemiluminescence view, do furnish the basis for a chemical explanation of H_2O_2 action

An additional experiment which supports the chemical view is that if we remove almost all the KBr from a plate prior to H_2O_2 treatment, by addition of a small amount of $AgNO_3$, not enough to give excess of Ag ions, the intensifying effect of H_2O_2 is considerably lowered

A full paper on this subject will be published shortly

E P WIGHTMAN
R F QUIRK

EASTMAN KODAK COMPANY,
ROCHESTER, NEW YORK,
SEPTEMBER, 1926

[1] Presented at the meeting of the American Chemical Society, Philadelphia, September, 1926

[2] E P Wightman and R F Quirk, *J Franklin Inst* 203, 261 (1927)

[3] W C Bray and R S Livingston, *J Am Chem. Soc* 45, 1251 (1923), R S Livingston and W C Bray, *Ibid.*, 45, 2048 (1923), R S Livingston, *Ibid*, 48, 45 (1926)

[4] K. C D Hickman, *Phot J* 67, 34 (1927).

[5] S E Sheppard, *Colloid Symposium Monograph* 3, 76 (1925), *Phot J* 65, 380 (1925)

[6] W Clark, *Brit J Phot* 70, 763 (1923); *Phot J.* 63, 78 (1923).

[7] S E Sheppard and E P Wightman, *J Franklin Inst.* 195, 337 (1923)

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BONDS OF UNION BETWEEN TROPICAL MEDICINE AND GENERAL MEDICINE[1]

IT is my wish that my first greeting and that my parting words should express my appreciation of the honor and the pleasure of visiting you here in Porto Rico It is distinctly profitable to me to have this opportunity of exchanging ideas and experiences with you in our chosen field of work In arranging for our conference this evening Dr. Lambert wrote to me suggesting that my talk ought to have a title, and he even ventured to hope that this idea would not come as too much of a surprise to me So I have selected a subject that will permit us to wander where fancy leads, perhaps, who can tell, to one or two unexpected developments

Our crowded activities grant us but little time for reflection, and it is easy to overlook points of contact between the adjacent fields such as tropical and general medicine Inevitably, these two fields have exerted a profound influence on each other

Strangely enough, the conception of tropical medicine is rather foreign to many individuals in the profession at home The very name sometimes tends to frighten people away To a few, it represents merely a curiosity, interesting but unimportant One of your obligations will be to arouse still further the interest and support in New York City of your work here One summer I met an elderly physician who had spent his life travelling in the tropics He said to me· "Mercy, no, I stay on the ship I never look at those patients ashore Why should I clutter up my head with all that nonsense? If I ever had to treat those diseases I'd go somewhere and take a month's course in the subject." A few of the more serious minded deceive themselves into thinking that tropical medicine represents a real opportunity to make distinctive discoveries of new etiologic agents and new and important clinical entities almost without effort Sometimes I feel that my friends almost take it to heart that the generosity of nature in tropical lands should cheat industry and so rudely violate the stern principles of no reward without great labor.

[1] A popular address delivered on February 22, 1927, as visiting lecturer at the School of Tropical Medicine, University of Porto Rico, San Juan, Porto Rico

Suppose, however, that we want to choose as a model a disease of extremely intricate nature, the details of which have been worked out with exactness It is best to turn to the tropics for an example. In the etiology of malaria we have not one but three distinct parasites very closely related, however, to the eye of the protozoologist they are readily distinguishable The transmission of the disease from patient to patient is a complicated process. The sexual forms of the malarial parasite come into prominence. They leave their intermediate host, man, to take up a cycle of development in their definitive host, certain species of mosquito. After the completion of this cycle the mosquito is ready to set up new infections in man. The pathology of the disease is well-nigh completely understood. The diagnosis in patients is reasonably exact The treatment, though not perfect, is marvelous compared to that of many bacterial infections. Lastly, prophylactic measures, though difficult, are quite feasible. The antimosquito campaigns have been enormously facilitated by Marshall Barber's ingenious introduction of Paris green for combating larvae

We look to Sir Patrick Manson and to the British nation as the founders of tropical medicine They took advantage of their natural opportunities Great Britain with her extensive possessions has many physicians employed in foreign service and they all come back to one spot The conditions in the United States are very different We have only a few men who go to the tropics and they come home to scatter across a broad continent A corresponding difference applies in the two countries to patients who are invalided home With us, this works to the disadvantage both of the patient and of the subject of tropical medicine In the absence of the incentive of stern necessity, interest has been intermittent and the development of the subject has been slow and arduous in the United States When I wanted to learn something of the scope of your new undertaking I turned not so much to the American medical journals for information but to the literature from Great Britain There have been some exceptions to this general lack of interest at home Occasionally some of our institutions have devoted a number of years of work and considerable sums of money to purely tropical problems, meanwhile carefully avoiding any permanent responsibility in this field There seems to be a willingness to profit by special opportunities arising in the field of tropical medicine accompanied by an unwillingness to offer continuous support to the necessities of the daily routine in this subject.

Clearly we can not model our schools after the British pattern. We must find somewhere compensating advantages in our own circumstances Here in Porto Rico one sees the fascinating opportunity of making a complete study of a disease. The hospitals provide facilities for thorough clinical observation. The laboratories stimulate the desire to experiment in many theoretical directions. But we are not satisfied until satisfactory results have been obtained in the prevention of disease under varying conditions and the unforeseen but interesting disadvantgaes of actual work in the field.

The finger of erudition is often pointed at the term "tropical medicine." Some medical men seem to feel that they have fathomed the mysteries of this term when they learn that workers in the tropics have frequently made the statement that there is no such subject as tropical medicine In one sense, I agree with this Admittedly the phrase is one of convenience rendered necessary by the geographical separation of diseases. But the distinction is justified on scientific grounds Fascinating fundamental principles are found in tropical medicine for which no counterpart exists in the diseases prevalent in cold climates Thus, for all intents and purposes, the insect hosts of disease and even the protozoan infections take no real part in the life of the student of medicine in the temperate zones Let me assure you, it is a difficult matter to find a satisfactory phrase for differentiating the medicine of cold climates from that of the tropics. "Internal medicine" does not help greatly Largely in a complimentary sense I have been using the expression "general medicine" In so far as general medicine permits itself to forego the subjects of protozoology and entomology, it becomes an important branch of the larger field of medical sciences

Well, this ought to convince you of my warning that we might be tempted to wander from any fixed topic I will not in any way attempt to sum up the more striking achievements of tropical medicine but will emphasize only those features in which this subject and general medicine have exerted an influence upon each other. Indeed, as already indicated, we must close some of the most brilliant pages of medicine

In my judgment, the most fundamental influence that tropical medicine has exerted in the field of medical sciences is to be found in the discovery of vitamins and the group of diseases sometimes designated as avitaminoses You remember when we studied medicine, not so very long ago, beriberi was classed among the specific infectious diseases, with the reservation that some unknown toxin might play a more or less decisive rôle We now know that neither of those factors plays any part whatever The clinical and epidemiological data seemed at times in the past to offer almost convincing evidence of

the infectious nature of this disease. Many striking incidents occurred in a manner almost suggestive of some conspiracy in nature to conceal the facts. For example, a ship with its crew in apparently good health would call at a port where beriberi prevailed. Then after some days the disease would, so to speak, "break out" among the crew. Furthermore, if a mother suffering from beriberi nurses her own child she becomes a serious menace to the health of that child. Such children are prone to develop beriberi in an acute form that terminates suddenly in death

But the Dutch investigators knew and had known for many years that beriberi was due simply to lack of proper nourishment. This discovery was made by Eijkman in 1890 There is an incident of a very human nature connected with Eijkman's production in chickens of experimental beriberi or, more accurately, polyneuritis At the time he was not working on beriberi at all and chickens are very likely the last animal that he would have selected for the study of beriberi The incident, as it was described to me, occurred in this manner The animal quarters for these experimental chickens lay at a little distance from the laboratory alongside the hospital building Very unexpectedly, the chickens developed polyneuritis to such an extent that the investigations that were in progress were seriously threatened. So Eijkman courageously decided that it was important to find out the cause of this polyneuritis Then, to his surprise, the chickens promptly recovered so he was obliged to go back to his original problem only to be interrupted again by the recurrence of polyneuritis Many observers would very justly have felt discouraged at this point. But Eijkman with remarkable skill succeeded in unravelling a mysteriously intricate network and revealed a clear chain of events occurring in logical sequence. The denouement came in this manner In the hospital the patients were served with polished rice For the protection of the patients, a rule was in force that any rice left on the patient's plates must be thrown out. In the laboratory the animal boy was given a small sum of money for the purchase of the cheaper unpolished rice for the experimental chickens. Now the Malays are very kindly in their disposition and the laboratory boy had a good friend among the orderlies in the hospital It does not require much imagination to see that it was easy to provide a handsome diet of polished rice from the hospital for the chickens in the animal house nearby There was no need wantonly to squander these valuable funds supplied for the purchase of unpolished rice. Now by mere coincidence, it happened that after the first outbreak of polyneuritis appeared, the orderly in the hospital went on vacation and the laboratory boy went back to feeding unpolished rice The symptoms disappeared and the animals recovered with mysterious rapidity. Then when everything was going nicely, the orderly returned to the hospital and the chickens resumed their diet of white rice and with it the symptoms of beriberi returned.

Looking back at this distance, everything is beautifully clear There is some strange substance in rice bran, in various grains, and in many other foods which is necessary for normal nutrition; in the absence of this substance polyneuritis develops. Eijkman picked his way with remarkable accuracy through this complicated maze in the face of many conflicting theories about beriberi His conclusions were promptly rejected The rest of the world said, "Oh, no, it just can't be true!" Twenty years later several investigators had the very happy thought of trying it. They made a discovery. They found that it is true. There is no flaw in Eijkman's experimental data, though his interpretation has subsequently undergone some revision.

Beriberi is not uncommon in the Philippine Islands The Filipinos offered information to the profession which was not utilized. Patients under treatment sometimes reported that they could cure themselves with a diet of a certain native bean. Not knowing the facts about beriberi at this time, we explained to them very kindly the error of their ways They accepted our explanations with gratitude and continued in their superstitious practice Their confidence was not misplaced, that is, their confidence in dietary measures was justified.

Barely a quarter of a century after Eijkman's first publication, the physiologists began an accurate investigation of the requisites of a balanced diet. The first steps were difficult. It was necessary to give up some old established comfortable views Proteins, carbohydrates and fats with a little salt and water had long been regarded as an adequate bread of life. Now it was rather disturbing to have to admit that some utterly unknown substance, even in minute quantity, exerts a powerful influence and is an essential item in our daily diet Funk used the term vitamin to designate this substance which prevents the development of beriberi As the interest in this phase of nutrition increased, other vitamins were discovered Recently one has been described by Evans in California which is concerned not with ordinary nutrition but with the process of reproduction. In the field of medicine investigators naturally sought to explain other diseases on the basis of a dietary deficiency It had long been known that scurvy is relieved by lime juice. Work of outstanding importance was accomplished by Goldberger in pellagra. Now in beriberi the problem is relatively simple; in

pellagra it is more complicated. Undoubtedly much valuable progress has been achieved in pellagra, but it is by no means certain that we have the complete story in hand as yet It is not clear whether a vitamin is lacking or whether the deficiency lies in some other factor The process of disproving the theory of a specific infection proved to be a long task even in the simple conditions of beriberi One frequently hears of pellagrins whose symptoms do not yield to dietary measures In this type of patient, it is particularly desirable to obtain additional evidence before utterly dismissing the idea of an infectious disease In brief we are forced into a somewhat unwelcome situation, it is clear that a dietary disorder can produce symptoms sufficiently like those of a specific infection to cause long-standing confusion

In the subject of etiology, let me mention first of all an interesting association between two diseases, that, let us say, seldom meet One of them, namely sprue, is truly a product of the tropics The other, progressive pernicious anemia, is a serious mystifying disease of cold climates So far as we can tell at present, it occurs at least very irregularly in the tropics. Here in Porto Rico sprue is endemic I intend to take full advantage of my opportunity to learn a great deal from you about this disease You all know of the important work of Dr Ashford on the rôle of monilia. As regards the causation of pernicious anemia, so little is known that one is fancy free to hold almost any view It may be a specific infection, or perhaps it is a disturbance of nutrition or it has even been regarded as a disorder of the blood-forming organs analogous to malignant disease With all the intensive study that has been made there is still very little to guide one along the correct path Any suggestion would be very welcome You may be interested to know that students of pernicious anemia are beginning to take an intense interest in sprue because of certain similarities which sometimes occur in these two conditions I refer more particularly to anemia, to achylia gastrica and to the changes in the spinal cord Here we have clearly a clue to be followed up and it is being followed by several investigators in the United States Considerable work is now in progress on the occurrence of monilia in pernicious anemia It is much too early yet to say what course this work may take, what it may develop into, or where it may eventually lead us You see that we are only at the very beginning of our knowledge concerning the cause of pernicious anemia But in the treatment of anemia very gratifying progress has recently been accomplished through dietary measures by Minot and Murphy The very name of this disease, progressive pernicious anemia, is sufficiently terrifying and there is already ground for hope that we may be justified in dropping the word "progressive" from this ominous phrase. By means of a diet of liver, patients suffering from pernicious anemia have experienced relief over periods of one to two years in a manner that has not been accomplished by any previous form of treatment

Now you all know that the old-established treatment of sprue rests on dietary measures This type of therapy, though very new in pernicious anemia, is an old procedure in sprue We have the strawberry diet, the milk diet and the meat diet. It is already time to consider the inter-application of dietary measures in the case of refractory patients afflicted with either of these diseases To illustrate, some sprue patients improve best of all on a meat diet but can not stand the monotony of this régime One would not hesitate to transfer such a patient to the diet of liver as used in pernicious anemia

We are now in a position to consider for a moment the question of etiology We are confident that an infectious process is an important factor in the production of at least some of the symptoms of sprue. In pernicious anemia, the relief of symptoms by a change in diet might be interpreted as evidence of a purely metabolic disorder But the analogy with sprue must be studied further As yet it would be premature to close our minds completely to the possibility of a specific infection in pernicious anemia. It would be a distinct advance if one could establish even the general type of disease to which this form of anemia belongs The geographical distribution of sprue and pernicious anemia renders it difficult for one individual to familiarize himself with the two diseases, yet a mutual understanding of the two is helpful.

I believe it was Pascal who gave us the important counsel that the apparently trivial exception sometimes opens up the way to unsuspected fields of important information In this connection let us remember that scarlet fever is not endemic in the tropics, but streptococcal infections occur here though perhaps with less frequency than at home This leads us, in a minor way, to something of a paradox. The weight of opinion in the United States at present tends toward the acceptance of the streptococcus as the cause of scarlet fever It has always been a puzzling question as to why scarlet fever does not occur in the tropics, if it is caused by a streptococcus the solution of this question becomes even more important You are all familiar with the happy results that are being accomplished in the treatment of scarlet fever with serum, this work having been initiated in your affiliated school in New York by Dochez and by the Dicks in Chicago Clearly there is an opportunity here in Porto Rico which does not exist in New York and Chicago to furnish supplementary evidence regarding

the etiology of scarlet fever I assume that no one here or elsewhere in the tropics has yet studied anew the streptococci found in the tropics and compared them serologically with those isolated from scarlet fever If the streptococcus found in scarlet fever occurs here, then one has the interesting task of discovering why it does not produce the clinical symptoms seen in cold climates Cases of scarlet fever are imported here occasionally, but perhaps the streptococcus is unable to persist in virulent form in this climate This would imply a subtle difference between this streptococcus and its close relatives Very likely one might be able to find an analogy for these circumstances, but the situation is sufficiently interesting to arouse the imagination

It is an easy matter to explain why some diseases are limited to the tropics We have in but very few instances arrived at a plausible explanation to tell us why some types of infection are found only in cold climates The subject of scarlet fever brings to mind the question of measles It is always helpful to see the same disease under varying conditions. The characteristics of life in the tropics offer certain minor advantages in the very difficult problem of the etiology of measles

We are all familiar with the world-wide distribution of bacterial diseases as a group, many species utterly disregard climatic conditions The protozoa are very discriminating and their home is distinctly in the warm climates Pathogenic amoebae do get something of a foothold in the north, but there is room for doubt as to how long they would maintain themselves there if the supply from the tropics were suddenly and completely wiped out The spirochaetes in their biological characteristics occupy a position which, in one sense, is intermediate between the bacteria and the protozoa Likewise, the geographical position of the spirochaetes follows an intermediate course There are a few pathogenic species which thrive entirely independently of climatic conditions, but the pathogenic group taken as a whole shows a predilection for the tropics.

Long ago Schaudinn suggested that the cause of yellow fever would prove to be a spirochaete and Stimson demonstrated a spirochaete in the kidney in one patient dying presumably of yellow fever The demonstration of leptospira as the causative agent of infectious jaundice added a fresh impetus to the search for spirochaetes in yellow fever Noguchi worked intensively in this field His results raise questions of fascinating interest regarding the relationship between yellow fever and infectious jaundice, *i.e.*, Weil's disease. The subject is an intricate one, and it will be best to reserve it for detailed discussion at a later period

Let us turn to an example where our information concerning the main features of etiology is complete It is one in which tropical medicine received very direct assistance from general medicine Clinical analogies had long been recognized between yaws and syphilis and even over-emphasized Following Schaudinn's announcement of the discovery of *Treponema pallidum*, Castellani very promptly supplied convincing evidence establishing a similar treponema as the cause of yaws Some of you may not recall that the treponema of yaws was actually seen by Castellani before *T pallidum* was described, but under such circumstances that Castellani did not appreciate its etiologic rôle The subject of tropical medicine just missed the opportunity of pointing the way to the etiology of syphilis Yaws and syphilis illustrate well the firm bonds of union between tropical medicine and general medicine It is impossible to appreciate either of these diseases thoroughly without a comprehensive knowledge of the other Yaws is one of the comparatively few diseases that is truly tropical and this geographical limitation is not dependent on an insect vector It seems to me by no means fanciful to regard syphilis as an evolutionary change in yaws for its adaptation to cold climates While the treponema of yaws is restricted to the tropics, it is indeed regrettable that nature has succeeded so well in adapting *T pallidum* to the rigors of cold climates

Thus the development of our knowledge of yaws owes a real debt to the general medical sciences not only as regards its etiology but also in the application of the Wassermann reaction. This debt has been in a large measure repaid in a way that is not fully appreciated Chemotherapy of the systemic infections received during its infancy almost its sole impetus from the field of protozoology and the spirochaetal diseases The development of salvarsan was very closely associated with tropical medicine As you know, trypanosomes and the disease trypanosomiasis, *i.e.*, sleeping sickness, furnish a practical method for the study of chemotherapy. Ehrlich, by systematic investigation, tested his long series of compounds on trypanosomes and on various spirochaetes. It so happened that salvarsan proved to be effective for many spirochaetal diseases, including syphilis. More recently the Rockefeller Institute devised a chemotherapeutic agent, tryparsamide, for the treatment of trypanosomiasis Some clinicians with an inquiring turn of mind tried the effect of this drug in the late stages of syphilis with results of decided interest

There is another achievement in chemistry that we must not pass over Under the conditions of tropical life, several important parasites can be demonstrated in the blood stream A good staining technique is in-

dispensable. The German workers in tropical medicine did their part in developing the Romanowsky stain to the point where it has become the routine method which is used in one form or another throughout the world in the study of blood conditions The modification devised by Giemsa has been applied by Wolbach in the study of sections, particularly for the demonstration of Rickettsiae in tissues. This technique has proved itself to be very valuable in attacking this interesting and difficult group of microorganisms

Biochemistry has also made its contributions Some years ago there was a small outbreak of Asiatic cholera in Manila At that time it fell to my lot to be on duty in the cholera wards Some of the patients in the stage of reaction showed unmistakable clinical signs of air-hunger, an almost typical Kussmaul's coma Obviously these cases were not associated with diabetes, and the urine, as a rule, was free from acetone. However, the clinical signs of acidosis were characteristic and it seemed advisable to look for some method other than the tests for acetone bodies for the recognition of acidosis Accordingly these patients were injected with sodium bicarbonate. Enormous quantities—90 or 100 grams—were often required to render the urine alkaline, whereas if a healthy person takes a teaspoonful of soda the urine changes promptly from an acid to an alkaline reaction. Formerly, a large proportion of all cases of Asiatic cholera, roughly 15 per cent., died of uremia Now it was found that early treatment of cholera patients with bicarbonate practically eliminated the complication of uremia Therefore it seemed probable that a similar lack of alkali might occur in patients developing uremia in the terminal stages of Bright's disease as we see it in cold climates Accordingly, in Baltimore I examined such patients They showed an even more intense degree of acidosis than the cholera patients, but obviously they were in the end stages of a long-standing disease and no lasting benefit could be expected from treatment with alkali For our understanding of nephritis it is important for us to know that acidosis is one of the factors which is responsible for the symptoms of uremia. This fact is now generally accepted, for it has been confirmed by many observers using chiefly the method of direct chemical analyses of the blood—a method that in my opinion is rather less delicate than the test of tolerance to alkali

These studies in Asiatic cholera therefore have given us an improvement in its treatment and a demonstration of a type of acidosis that differs markedly in detail from that of diabetes. This acidosis occurs not only in the nephritis of cholera patients but also in the ordinary nephritis of cold climates.

Before leaving the general field of chemistry, let us look kindly and briefly at a small and now harmless skeleton behind the curtain An error of a pharmacological nature delayed the development of emetine therapy in amoebic dysentery for two decades From time immemorial the natives of India had known that ipecac often, though by no means always, gave relief in the treatment of dysentery With the differentiation of the amoebic and bacillary forms of dysentery, medical men became more and more interested in ipecac treatment Now if any of you have ever had occasion to undergo the old ipecac treatment, you will know what a heroic undertaking it is to manage sixty or ninety grains of this drug, on account of the fearful nausea that ensues In an honest effort to advance the use of ipecac, the idea was put forth that the drug does not owe its action to its content in emetine For a time this conception gained ground In my day in medical school we were advised to use de-emetinized preparations of ipecac in treating amoebic dysentery. It seems strange that this error was not corrected by the experience gained in actual practice One possible explanation is that some of the presumably de-emetinized preparations still contained appreciable quantities of emetine The correction of this error came about twenty years later in this manner. Vedder working in Manila found that emetine was very toxic for the cultures of the harmless water amoebae and he advised that the pure alkaloid be tried in the treatment of infections with *E histolytica* Rogers acting on this suggestion developed the treatment of amoebic dysentery by the intramuscular injection of emetine

We must at least mention the topic of climatology We may look forward to interesting advances in this subject in the future Under natural conditions, it is very difficult to judge the effect of climate on man. There are many variable factors which are not susceptible of control and the effects are not susceptible of exact analysis. Accordingly, some wonderful laboratories have been equipped at home in which artificial climates may be produced and regulated at will. The problems are numerous; some physiologists are interested in determining the effect of climate on the nervous system and on the mental processes of the individual.

In matters pertaining to climate, I would rather turn to the infectious diseases Radical theories have been advanced suggesting that infectious diseases may change profoundly under the influence of climate. Diseases may be limited by climatic conditions. In the main, they refuse to change their symptoms and

their general behavior. To illustrate, it is now accepted that syphilis and yaws are distinct diseases We no longer hold the view that syphilis under tropical conditions changes its manifestations and gives rise to yaws

Permit me to point out one very interesting organism, namely, *B. pestis,* the causative agent of bubonic plague. This disease is transmitted by the rat flea. But at times, especially in northern climes, this same bacterium *B pestis* has given rise to a disease characterized not by buboes but by pneumonia and we have pneumonic plague Occasionally, cases of bubonic plague also develop pneumonia, but epidemics of the pneumonic form occur only in cold climates Insects play no part whatever in transmission, but droplet infection is the mode of conveyance Droplet infection explains itself Some of you may remember having been in countries so cold that on stepping out of doors in the morning you could "see your breath" on the air It is this "breath" which carries microorganisms with it The organism *B pestis* is easily recognized in each of these two types of disease Otherwise a strange error might easily have occurred It would have been only natural to suppose that these two types of infection were totally unrelated diseases, one a pneumonia, always fatal, and epidemic in cold climates, the other a disease of rats and man, carried by fleas and characterized by buboes

Let us now take up briefly some phases of epidemiology and hygiene Manson really shocked his best friends by suggesting that filaria, a parasite found in the blood, might be transmitted by mosquitoes Undaunted, this pioneer demonstrated in 1878 that certain species of mosquitoes take up filaria from the blood of a patient Moreover, he followed developmental stages of the filariae in the mosquito The manner in which the mosquito carries the infection back to man was not demonstrated for a period of many years In the meantime it fell to the lot of Theobald Smith to furnish the first complete demonstration of "insect" transmission As you know, he showed clearly that the disease Texas fever, which affects southern cattle, is transmitted by the cattle tick In spite of very clear experimental evidence, this conception proved almost too daring for scientific acceptance by the leaders in medicine of that period. In the face of skepticism, the demonstration of the insect transmission of malaria, of yellow fever and other diseases soon followed. An incident occurred in Cuba which expresses very well the attitude in that day toward the insect transmission. You remember that Dr. Carroll, of the yellow fever commission, submitted to an experimental infection with this disease. When his infection was fully developed he told his nurse one evening that his attack of yellow fever was produced by the bite of a mosquito. During his convalescence, Dr Carroll was looking through his clinical chart and he found this entry by the nurse, "Patient is delirious to-night, says he got his fever from a *mosquito bite.*" Eventually a long list of infections have been shown to be insect borne. Indeed it might seem that an easy way was opened up to determine the rôle of insects in transmitting an infectious disease The problem however is not quite so simple I would call your attention to the stubbornness with which kala-azar has steadfastly refused to yield the secrets of its way of life in the insect world. It seems now, under the attack of the three commissions engaged for some years in field work, that kala-azar is almost proven to be transmitted not by fleas nor the lowly bedbugs but by sand flies.

One of the very few absolute triumphs in hygiene in the United States was accomplished by virtue of the demonstration in Cuba concerning the rôle of mosquitoes in yellow fever This disease has now vanished from general medicine of our northern cities, probably never to return A relative triumph in hygiene in our southern states owes its origin to the demonstration by Ashford and his colleagues here in Porto Rico that uncinariasis can be controlled by appropriate field measures. It challenges the imagination to conceive the far-reaching ramifications of this work that had its beginning here only a few years ago Recently this work has received a fresh impetus by virtue of the remarkable advances made in Washington by Hall and his associates in antihelminthic therapy The splendid development of the hookworm campaign throughout the world reached such proportions that the practical difficulties multiplied themselves The introduction of carbon tetrachloride by Hall furnished a reviving influence to this campaign.

One could easily multiply the instances in which remarkable results have been achieved through public health measures in cold climates for the purpose of driving back to their home the diseases originating in the tropics

Recently I have had the pleasure of visiting the department of health and the privilege of seeing something of the work of your director of public health. The achievements in hygiene in Porto Rico are progressing to such an extent that the workers in this institute will be driven not merely to neighboring islands but farther and farther from these shores on expeditions for research in its many and varied phases. There are advantages and disadvantages about these expeditions. The one thing we can be sure of is that they are a necessity.

Obviously the opportunities for teaching here are splendid. I hope it may be your privilege to bring about a closer association in work, in thought and in

the exchange of ideas between the staffs of this school and that of your affiliated school in New York. Perhaps you may enjoy the distinction of seeing these two branches of medicine grow into one subject. Fortunately you do not have the responsibility of providing here a complete course in general medicine. Our schools at home are carrying a burdensome curriculum that is constantly growing. But think of the situation which pertains, for example, in the University of the Philippines. There the students must be given a thorough foundation not only in general medicine but they must also be prepared to meet the daily problems in protozoology, helminthology and entomology. After all, the ideal location for a school of general medicine is in the tropics. Such schools have not as yet attained the distinction of a genuinely international reputation. The opportunity for the time being is lying dormant.

We have sketched very lightly some of the more obvious ways in which the interests of tropical and general medicine are intermingled to form the growing structure of the medical sciences. We have illustrated this by a consideration of vitamins and their relationship to beriberi, scurvy, rickets, pellagra and to the physiology of nutrition and reproduction. You have before you now the important results which have just been achieved in the study of rickets by the commission from the Yale Medical School. The relationship of sprue and pernicious anemia commands special interest here in Porto Rico. The study of the streptococci in the tropics will aid in advancing our knowledge of scarlet fever. Among the spirochaetal diseases there is much opportunity for reflection. We have the treponema of syphilis and yaws and the leptospira of Weil's disease and yellow fever. In the field of biochemistry, progress has been made in the study of nephritis as it occurs in Bright's disease and in Asiatic cholera. Turning from medicine to hygiene, we find in many respects a common interest in principles, and the necessities of travel and commerce bring about a closer association in practice. In the experience of the individual these relationships can as a practical matter be but little more than points of contact between the medicine and hygiene of these distant zones. As we look more closely we find firm bonds of union between the medical problems of lands that lie always in the summer sunshine and those accustomed to perpetual fog.

Little did the physiologists dream that a fundamental discovery in nutrition would originate in the small island of Java. Nature has lavishly endowed this island of Porto Rico. Its stimulating freshness lends inspiration for work and for ideas. The richness of your chosen subject defends it against monotony. Here it will be easy and natural to follow the precept recommended by Professor Williams at the founding of the Sigma Xi. He said in part, "In kindling your torches we bid you light them at the brightest living altars of learning and not at the smouldering embers of dead issues." As the years slip by, many students will look back with satisfaction on the incentive received in this favored place.

It is a matter of importance to the scientific world that the people of Porto Rico have achieved a definite consciousness of their responsibilities in science. The leaders in the development of this island are not satisfied merely with commercial progress. The activities of your investigators have given Porto Rico a place of leadership in science in tropical America. This is an enviable position which in time will be challenged by your neighbors in friendly rivalry. But with the foundation of past achievement and with mature plans and preparations for the future, it is a leadership which Porto Rico is in a position to maintain.

ANDREW WATSON SELLARDS
DEPARTMENT OF TROPICAL MEDICINE,
HARVARD MEDICAL SCHOOL

NOMINA CONSERVANDA

AN article in the November, 1926, issue of the Proceedings of the Entomological Society of Washington by Mr. W. L. McAtee, entitled "Nomina Conservanda from the Standpoint of the Taxonomist," shows such an astonishing failure to grasp the relations that exist between nomenclature and taxonomy that I can not permit it to pass without protest.

"Why do scientists," queries Mr. McAtee, "most of whom presumably are evolutionists, attempt to block development in taxonomy while constantly accepting change in other fields both within and without the domain of science?" The inference is that adherents of the idea of nomina conservanda must answer to the charge of being obstructionists. The answer is that they do not attempt to block development in taxonomy, no such charge could be made by one who understood the function of the rules of nomenclature.

Taxonomy concerns itself with the classification of organisms, and modern taxonomists accept the principle that classification must express, as nearly as may be, organic relationship. In a word, taxonomy must as closely approximate the phylogeny of organisms as the state of our knowledge makes possible. It is therefore a science, and, like all sciences, is dependent upon our knowledge of facts and our interpretation of the significance of the facts we know. It would be intolerable to have it codified or ruled upon by any group of individuals, however organized, for it is the bounden duty of every man of science to make known the facts of science as he perceives them,

and it is his inalienable right to interpret those facts according to his own best judgment.

The nomenclature of organisms is, on the other hand, a matter of language It is a tool that the taxonomist must use, and use well, in common with all other zoologists, too A central body can regulate it, and should do so, for only in so far as it is standardized and universal is it useful, and in so far as it is individual is it not a tool at all, not a language, but babel Mr McAtee may prefer to babel names that no one else understands and has the inalienable right to do so, but if I, on the other hand, wish to apply my names in a manner that has been standardized by reasonable central authority and therefore make them intelligible to others, Mr McAtee may not imply that my course is less progressive or that I am, in so doing, obstructing scientific progress

The rules of nomenclature never attempt to settle the status of organic groups Neither they in general nor nomina conservanda in particular settle or rule upon matters of scientific fact nor the interpretation of those facts Given one hundred individuals, Mr McAtee may interpret them as one hundred species, and one hundred genera—one hundred families if he likes and has the inalienable right to do, nor will any ruling of nomenclature or any proposition of nomina conservanda prevent it, any more than it would prevent me from considering, if I so chose, that they were all one species The rules of nomenclature say that *if one accepts* a certain group of organisms as having the status of species, subspecies, genus or what not he shall apply to them such and such a name, and they also provide what name he shall use if he change that status or accept them as of another status, or if he dissociate them from a group with which they have been previously combined or combine them anew with others About what course the taxonomist shall follow in all these matters the rules of nomenclature are silent, for it is none of their concern

Just that fact is the reason why the hope that any rules of nomenclature could or should afford a permanent stability in all cases is futile. Such an expectation is based on ignorance. Even theoretically they can only attain a nomenclatorial stability in so far as taxonomy remains stable

If I to-day call species z and y both members of the genus A-us, and to-morrow decide that they are not, no rule of nomenclature can nor should prevent prevent me from then calling the one A-us z and the other B-us y, a change of name corresponding to the change of taxonomic status. If to-day I call two individuals both species z and to-morrow I do not, no rule of nomenclature can nor should prevent my assigning a new name to one of them. If I assign ten genera to one family, and Mr. McAtee assign them to ten families, no rule of nomenclature nor no nomen conservandum can nor should prevent his act, nor all the changed family names under which those organisms would thereafter be ranked, but if he follow his course (or I mine) the rules may prescribe what names we must use

All rules of nomenclature must provide for unlimited change, corresponding to changed taxonomic concepts, and they do To this nomina conservanda are no exception

A nomen conservandum does not attempt to set up a status quo, thereby dictating for all time that a name shall be used for a group of specified limits It does not specify the limits of a group for any time, no rule of nomenclature does so They are not concerned with limits, for limits are questions of fact, or of judgment—not arbitrable, belonging to taxonomy Just because it can *not* deal with limits nomenclature can only deal with types It can only define a genus as all those organisms which any given taxonomist accepts as congeneric with the type species It proclaims, and only proclaims, that now and for all time all those species[1] which any given taxonomist considers as congeneric with a specified type species shall by him be called by a specified generic name It equally provides that any taxonomist, not considering some of these as congeneric with the specified type, shall not use that generic name in combination with them.

Therefore, given the Genus A-us, type species z, the principle of nomina conservanda may provide at one and the same time that Mr Blank, accepting species x as congeneric with z, shall use the combination A-us x, and that Mr Brown, not accepting species x as congeneric with z, shall *not* use the combination A-us x, which is right and as it should be

Mr McAtee goes on to say, "Certainly there is no real value in preserving a familiar name unless it embodies a definite concept Proponents of nomina conservanda assume that these names do embody such concepts, but this is a fallacy In fact, the longer a name has been in use the more we may be assured that authors have applied[2] it to diverse organisms

[1] So far the principle of nomina conservanda has only been applied to generic names If extended to specific names, or to family or other group names the principle would be identical, except that no principle of nomina conservanda could tolerably be applied to a combination of generic and specific names, other than for the name of a genus and that of its type species, for that proposition would instantly involve the limits of genera, and therefore taxonomic decisions.

[2] Misapplied would be better It is the duty and purpose of rules of nomenclature to clear up and prevent such misapplications But Mr McAtee may mean cases

If Mr McAtee will substitute the modern concept of a taxonomic group as its type and all other organisms that any given zoologist accepts as properly belonging to the same group for the old idea that a group consists of all organisms that come within its original definition he will see that the limits of a group may be as variable as the number of taxonomists who study it, but that its *nucleus* must remain fixed. With that understanding the force of the quoted sentences and of those that follow withers.

Mr McAtee continues with his confusion between taxonomy and nomenclature

> "The definite concept idea is not retroactive Furthermore the definite concept idea has no anticipatory value, *for we can not be insured against future change* Taxonomy is dynamic not static, and its development demands never ceasing perfecting of analysis and definition Setting up nomina conservanda is attempting to establish fixed entities in a field where change, where progress, necessarily has been the rule It amounts to fixing limits to the search for knowledge "

If the name A-us is a valid name for a generic group, consisting of species z as type and others, and ten different authors have used ten different generic names for groups in which they included (as type) species z all since the original proposition of the name A-us, obviously the definite concept idea is not retroactive in the sense that it can alter the fact that they have done it, but it is retroactive in the sense that it can proclaim that from our standpoint these were misapplications not to be followed And it is anticipatory in the sense that it can proclaim that for all future time that particular organism and any others that the future may include with it as congeneric, if any, can only be termed the genus A-us Taxonomy *is* dynamic and not static, but we must have an intelligible language for it, and our nomenclatorial system provides for unlimited flexibility, change, progress A nomen conservandum differs from any other name only by the fact that for especial reason, by common agreement we have decided that a particular name E-us shall apply to the type of a genus and its accepted congeners (accepted by any given worker—not by any pronouncement) instead of any other name as A-us, which the rules might perhaps otherwise validate Its effect never is to limit a generic concept, but only to fix a nucleus and a name, its result is therefore to stabilize and standardize nomenclature, but not to limit the search for knowledge There is no "sacrifice of scientific ideals of evolution in methods and of progress in knowledge" There can not be, for these things are not involved.

"Furthermore they [*i e*, nomina conservanda] can be established only by nullification of the fundamental principle of nomenclature, priority" Why is priority fundamental and how far? Only because it has proved a useful tool and only so far as it is a useful tool "Priority" is a convention to be discarded just at the point where it begins to impede instead of helping

The generic name Crabro has been universally used in literature for a common and well-known group of aculeate wasps, in accordance with a usage introduced by Fabricius in 1775 It has escaped all authors (until it was pointed out in 1919) that this name had been used by Geoffroy in 1762 for a well-known group of saw-flies, universally since his day called Cimbex By the law of priority we are hereafter obliged to call the saw-flies Crabro instead of Cimbex, and to call the wasps by some other less familiar name That is an exceedingly confusing and awkward thing to have to do It is not helpful in the case of these names, it is an abomination But the writer and others who feel with him believe that it is better to accept an abominable situation and make the best of it in an occasional instance like this than it is on his own authority or that of any individual to abrogate the law of priority, which common agreement and experience has shown to be a useful tool If we can by common agreement through a representative body decide selectively in such special cases that it is more useful to abrogate the principle of priority (or any other convention) than to follow it, we are relieving an abominable situation, and proving ourselves masters of our tools instead of slaves to them That process is what we call establishing nomina conservanda. It is not a bogey to be afraid of It is an act of common sense. The danger is only when individuals attempt to establish them by their own unsupported acts, for by their very nature they are useful and tolerable only by common agreement and adoption.

The next argument enunciated by Mr. McAtee is that the actuating purpose of a taxonomist's work is to build himself a monument and that the institution of nomina conservanda threatens the names that the taxonomists originate and which are to be their monuments I can not read that paragraph without growing angry The taxonomist who works to build himself a monument had better turn to another field: if

of organisms once supposed to be identical, but which with the lapse of time and the growth of knowledge are now known to be diverse—or supposed to be In such instances the misapplication would only become such after the diversity was known, and by one who accepted the diversity as a fact Neither case invalidates the idea that nomina conservanda apply to a definite conception —namely a type and all other organisms accepted by any given zoologist as of the same group

his reward does not come from the joy of discovering new truths and relations and helping others to discover them, his work is more likely to be an impediment to progress than a useful thing Taxonomy has suffered too much in the past and fallen too far into disrepute, from the petty work of persons infected with the "mihi itch" Were it not a bibliographical necessity—or so considered—it would be *far* better to not cite the name of an author in conjunction with a scientific name and to forget who proposed it At least the sooner it is understood, the better off we will be, that we do *not* include the name of the author as part of the formal name of an organism in order to give him "credit," but as a matter of bibliographic record If it must come to a question of a monument to posterity, there are those who would prefer to leave taxonomic work that would win the approbation of specialists for its sound judgment of phylogenetic relationships, for its scholarliness and helpfulness, even though it never proposed a new name, than to have coined names for a thousand genera and species, each flaunting the describer's name like a waving ensign to dazzle the uninitiated, who may not know how easy and insignificant a thing it is to propose a new name or describe an avowedly new form.

"Taxonomists originate the names, work with them more than other scientists, and in all ways have greater interests in them, and rights over them" As a taxonomist I protest against any such point of view, or against Mr McAtee thinking that he speaks for "entomological taxonomists almost to a man" The language of zoology is the common property of all zoologists If the taxonomist allows himself to become so sunk and enmeshed in his own limited group that he can not see, or disregards the needs of the non-specialist in that group for an intelligible nomenclature of it, if he fails to meet the legitimate needs of the general zoologist, of the morphologist, of the ecologist, he may expect that the general workers will ride rather roughly shod over him, for they will not tolerate hampering of their progress in a field that should contribute only cooperation and facility

The principle of nomina conservanda is sane, sound common sense, when properly applied. It permits us to use the rules of nomenclature up to the point where they serve a useful purpose and to abrogate them just at that point where their further employment would be an unquestioned detriment. The "plenary power" resolution of the Monaco Congress gave the International Commission power to suspend the rules in any given case where in its judgment the strict application of the rules will clearly result in greater confusion than uniformity. It is like the executive clemency principle, which recognizes that in individual cases greater injustice may be done by application of the law and its penalties than by their suspension But unlike executive clemency it is not subject to political considerations or to individual motives It *must* be the unanimous[3] act of an international board of experts—the only representative body of zoologists that exists There have been very few cases in which this power has been used; and that the commission will be conservative in its future application may be taken for granted No individual or other body has any recognized right to establish a single nomen conservandum That this power now exists in the International Commission is a cause for congratulation, a progressive step, a sign that we are to be bound by convention and rules only to the point where they serve a useful purpose, and are not to allow ourselves to become their slaves

J CHESTER BRADLEY

CORNELL UNIVERSITY

SCIENTIFIC EVENTS

A CODE OF ETHICS FOR SCIENTIFIC MEN

THE Committee on Social and Economic Welfare of Scientific Men, appointed at the Phoenix meeting of the Southwestern Division, American Association for the Advancement of Science, presented the following tentative code of ethics for discussion at the Santa Fe meeting of the division, April 13, 1927 The code was unanimously adopted

(1) Assume an obligation to do honest work and to impartially present the same to the public, regardless of political, economic or religious prejudice, pressure or tradition

(2) Exemplify in your conduct and work a courageous regard for the whole people, and not alone some powerful and influential fraction thereof with which you come in close personal contact

(3) Recognize and assume a dual obligation (a) to do the best possible work in your field, (b) to promote the social and economic welfare of your colleagues and yourself

(4) Promote the dignity of your profession; avoid malicious criticism of colleagues, cultivate a professional consciousness

(5) Support laws to insure competency and high standards on the part of scientific technical men in every field

(6) Respect yourself and your profession, do not underbid your colleagues, insist that the laborer is worthy of his hire

(7) Be slow to change jobs and institutions where such a change means a loss of project efficiency, but do not

[3] A two-thirds agreement results in final decision by a special committee appointed by the succeeding International Congress of Zoology.

hesitate to change where the attitude of autocratic superiors, miserably inadequate pay or other conditions conducing to inexcusable inefficiency menace the entire service you are endeavoring to perform

(8) Investigate before accepting a new position; do not become a candidate for any position from which the previous incumbent was unfairly or wrongly dismissed, or a position in any institution under the ban of dignified organizations of scientific men

(9) Insist on such a measure of reasonable participation in the determination of policies in your institution as will best promote effective scientific work.

(10) Do not publish the work of colleagues or subordinates without giving full credit where credit is due, authorship should be determined on the basis of the responsibility for the ideas involved, conception and organization of the project, actual field or research work, and actual compilation and writing of the results

(11) Avoid, alike, hasty and superficial publication, and the holding of real results indefinitely without publication

(12) Take the public into your confidence, in the end the public pays the bills and has a right to know what is going on

(13) Interest yourself in human concerns outside your specialty—politics, religion, economics—your obligation to serve the community along these lines is directly proportional to your training and real ability

The Committee on Social and Economic Welfare of Scientific Men is composed of the following members Byron Cummings, acting president, University of Arizona, *chairman*, Frank E E Germann, University of Colorado, Boulder, G A Pearson, Southwestern Forest Experiment Station, Flagstaff, Walter P Taylor, U S Biological Survey, Tucson The committee will cooperate with the Committee of One Hundred on Scientific Research of the general association in its work for the advancement of research and research workers

THE WORLD LIST OF SCIENTIFIC BIBLIOGRAPHY

THE World List of Scientific Periodicals published by the Oxford University Press has been completed The London correspondent of the *Journal* of the American Medical Association writes

Few as large, and certainly no more arduous, tasks in bibliography have ever been accomplished The first part of this great undertaking was to compile in alphabetical order a list of all periodicals containing the results of scientific research in existence between the years 1900 and 1921 This was published as volume 1 in 1925. It contains the stupendous number of just over 24,000 separate periodicals But the list was not complete, notwithstanding the exhaustive search of known catalogues made by Dr Pollard, then keeper of printed books at the British Museum, and in a supplement issued with volume 2 more than 600 periodicals have been added. The preparation of the second volume necessitated even greater labor and has performed an even more important service to science. The adage "verify your references" is made difficult, sometimes impossible, by the ambiguous abbreviations of titles often given by authors. To overcome these difficulties, several institutions have adopted their own sets of abbreviations These, however, are for the most part based on a limited series of periodicals, and also differ among themselves. The second volume of the World List consists in the first place of a set of abbreviations consistent and unambiguous for the whole set of nearly 25,000 periodicals. If it could be universally adopted, the temporary inconvenience of changing existing systems would soon be overcome by the permanent advantage to all scientific workers Even when a reference is given correctly, the seeker after knowledge has to discover where he can find the periodical To aid in that, twenty one centers in Great Britain and Ireland have been selected. Symbols have been assigned to the more important libraries in each of these centers, and after the contraction for each periodical is placed the symbol of libraries in which the periodical is to be found But apart from the direct aid supplied in this way, some remarkable and disconcerting results have appeared, because for a considerable proportion of the periodicals no home in Great Britain and Ireland has been discovered Even London, with twenty seven important scientific libraries, misses many publications of high value.

A CENSUS OF WATER-FOWL

A MONTHLY census of water-fowl at selected points throughout the United States is being planned by the Biological Survey of the Department of Agriculture. It will be an aid in administering the Federal migratory-bird treaty act and the regulations thereunder, for the protection of birds that migrate between the United States and Canada The undertaking is for the purpose of obtaining accurate information regarding the numbers, distribution and migration of water-fowl throughout the United States, Canada and Mexico. The project is important not only to the country as a whole and to each of the states, but also to all organizations that are primarily concerned with the conservation of game, all sportsmen and all others interested in wild fowl or their conservation

In carrying out this projected work the Biological Survey plans to establish as many volunteer observation stations as possible, particularly in areas where there is great concentration of water-fowl in winter or during migration In addition, it is desired to gather all possible information regarding the numbers and distribution of our water-fowl during the breeding season. On the selected areas accurate counts or estimates of ducks, geese, swans and coots are to be made throughout the country each month on the same designated dates When the numbers of birds

are small enough actual counts will be made, and otherwise, estimates of their numbers. Accuracy in these counts and estimates is insisted upon as of prime importance to the purpose of the work.

It is hoped by these censuses to learn not only more than has before been possible to know of the numbers of the ducks, geese, swans and coots, but also additional facts regarding their distribution and their migration routes. By repeating the observations during succeeding years it will be possible to determine whether these birds, so important to the sportsmen and to the country at large, are actually increasing or decreasing. It will also throw light on the causes of local fluctuations that often are puzzling. Each census taker is urged to select the area of great concentration in his locality and one that can be conveniently covered in a single day or a portion of a day.

This project will be inaugurated during the coming August. Cooperation is assured from various agencies of the United States Government, including the National Park Service, Lighthouse Service, Coast Guard, Bureau of Fisheries, Bureau of Reclamation, Office of Indian Affairs, Bureau of Education, and the Forest Service, Weather Bureau and Extension Service of the United States Department of Agriculture. Cooperation has been invited from sportsmen, ornithologists and other interested organizations and individuals.

THE STUDY OF EPIDEMIC ENCEPHALITIS

DR. WALTER TIMME, chairman of the joint finance committee of the trustees and medical staff of the Neurological Institute at the new Medical Center, New York City, recently made the announcement that to promote research study and treatment of encephalitis J. P. Morgan has made a gift to the institute of $200,000 to be used for the construction and equipment of a complete hospital floor containing forty-eight beds. The gift was designated as a memorial to Mrs. Morgan, who died of the disease.

The Morgan fund places at the disposal of the medical profession facilities for investigating sleeping sickness and will enable the institute to bring to bear upon this problem the combined resources of the entire Medical Center, now in the process of completion at 165th Street and Broadway.

That the disease of this country and England differs from that found in Africa was pointed out recently by Dr. Aldo Castellani, discoverer of the germ of that disease, who came to this country to organize a department of tropical medicine at Tulane University.

So wide is the territory covered by the malady in its varied forms that it has been apparent for some time to the medical authorities that an international survey of all expressions of the so-called sleeping sickness would be the only logical method of determining the extent of the germ's range.

Mr. William T. Matheson has provided funds to pay the cost of a survey of encephalitis in this country, Europe and possibly Asia. A commission has been formed with Dr. William Darrach, dean of the College of Physicians and Surgeons of Columbia University, as chairman. The commission includes Dr. Frederick Tilney, professor of neurology in Columbia University, Dr. Hubert Howe, instructor of neurology, secretary, Dr. Haven Emerson and Dr. Frederick Gay, who are both on the faculty of the same college as professors of public health administration and bacteriology, respectively, and Dr. W. J. Park, director of the bureau of laboratories of the New York City Health Department and professor of bacteriology of Bellevue Hospital Medical College. Direction of the research program will be under the supervision of Dr. Josephine B. Neal.

THE ROCKEFELLER FOUNDATION

IN his review of the work of the Rockefeller Foundation, Dr. George E. Vincent, the president, states that during 1926 the foundation, in disbursing $9,741,474 (1) aided the growth of fourteen medical schools in ten different countries, (2) maintained a modern medical school and teaching hospital in Peking, (3) assisted the development of professional public health training in fifteen institutions in twelve countries and in ten field stations in the United States and Europe, (4) contributed to nurse training schools in the United States, Brazil, France, Poland, Jugoslavia, China, Japan and Siam, (5) sent, as emergency aid, journals, books or laboratory supplies to institutions in twenty European countries, (6) helped twenty-one governments to combat hookworm disease, (7) gave funds to organized rural health services in 244 counties in the United States and to thirty-four districts in twelve other countries; (8) shared in the creation or support of various departments in state or national health services in sixteen countries, (9) cooperated with Brazil in the control of yellow fever, or in precautionary measures against the yellow fever mosquito, in ten states, (10) continued yellow fever surveys and studies in Nigeria and on the Gold Coast; (11) aided efforts to show the possibilities of controlling malaria in nine North American states and in Porto Rico, Nicaragua, Salvador, Argentina, Brazil, Italy, Spain, Poland, Palestine and the Philippine Islands, (12) helped to improve the teaching of physics, chemistry and biology in eleven institutions in China and in the government university of Siam, (13) supported the Institute of Biological Research of the Johns Hopkins University and con-

tributed toward the publication of *Biological Abstracts*, (14) gave funds for biological or mental research at Yale University, the State University of Iowa and the Marine Biological Station at Pacific Grove, California, (15) provided, directly or indirectly, fellowships for 889 men and women from forty-eight different countries, and paid the traveling expenses of sixty-nine officials or professors making study visits either individually or in commissions, (16) helped the Health Committee of the League of Nations to conduct international study tours or interchanges for 120 health officers from forty-eight countries, (17) continued to aid the League's information service on communicable diseases, (18) made surveys of health conditions, medical education, nursing, biology or anthropology in thirty-one countries, (19) lent staff members as consultants and made minor gifts to many governments and institutions, (20) assisted mental hygiene projects both in the United States and in Canada, demonstrations in dispensary development in New York City, and other undertakings in public health, medical education and allied fields

SCIENTIFIC NOTES AND NEWS

AT a *conversazione* held by the British Institution of Electrical Engineers, on July 7, at the Natural History Museum, South Kensington, the president presented to Dr Elihu Thomson, honorary member of the institution, the Faraday medal which had been awarded to him by the council

AT the fifth centenary of the founding of the University of Louvain, on June 29, honorary degrees were conferred on Dr Simon Flexner, director of the Rockefeller Institute, on Edward Dean Adams, the electrical engineer, and on Alfred Douglas Flinn, secretary of the American Engineering Society, New York

AT the commencement exercises of the University of Porto Rico held in San Juan, Dr. Juan Iturbe, of Caracas, Venezuela, received the honorary degree of doctor of science

THE president and council of the Royal Society have recommended Mr Stanley Baldwin, the British prime minister, for election into the society under the special statute which permits the election of persons who, in their opinion, either have rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the society

PROFESSOR SIR EDWARD A SHARPEY-SCHAFER presided over the section of physiology and biochemistry of the British Medical Association meeting in Edinburgh during the latter part of July

AT the annual election of fellows into the council of the Royal College of Surgeons of England, Sir Berkeley Moynihan presiding, there were nine candidates for three vacancies. The following was the result of the election Sir Cuthbert Wallace (489 votes) and Mr. William Thelwall Thomas, M.B.E (475 votes), were reelected, and Mr Hugh Lett (366 votes) was elected a member of the council

THE German Society for Cancer Research on July 4 gave a dinner in honor of Dr Frederick L. Hoffman in the Zoological Garden, following an extended address by Dr Hoffman on the utility of statistics in cancer investigations. The presiding officer was Dr Kraus, president of the society Among those present were Dr Otto Warburg, Dr Hamel, president of the Federal Health Department, Dr Krohne, minister of public welfare, Dr Blumenthal and others

DR. EDWARD KREMERS, professor of pharmaceutical chemistry in the University of Wisconsin, has resigned to organize and direct research in colloid chemistry for E I du Pont de Nemours and Company, at Wilmington, Delaware

THEODOR THEODORSON, of the Johns Hopkins University, under the auspices of the Oil Heating Institute, has been placed in charge of research work on the process of combustion in an oil flame Mr Leod D Becker, managing director of the institute, states that this is the first time that a well-coordinated investigation into the air-fuel ratio, shape and size of combustion chamber, possible draft variations and methods of mixing fuel in domestic oil burners has been planned by non-commercial authorities.

HORACE S. ISBELL, who has been working on organic gold compounds for the United States Public Health Service at the University of Maryland, has resigned to accept a position as associate chemist with the Bureau of Standards, Washington, D. C

DR. ELLA WOODS has resigned her position as assistant professor of home economics in the University of Wisconsin in order to take charge of the research work in home economics under the Purnell Grant at the University of Idaho.

AT the recent meeting of the trustees of the Beit Memorial Fellowships for Medical Research, Dr. H H Dale, head of the department of biochemistry and pharmacology of the Medical Research Council, was appointed a member of the advisory board in succession to the late Professor E. H. Starling.

DR. B T. DICKSON, professor of botany at McGill University, Montreal, has been appointed by the Australian government chief mycologist of the Council of Scientific Industrial Research.

DR. C L. HUSKINS, of the University of Alberta, who has been carrying on his researches on the cytology and genetics of fatuoid oats for the last two years in the botanical department at King's College under Professor R R Gates, has been appointed to a research post in the John Innes Horticultural Institution at Merton

To complete the unfinished work of Dr Charles D Walcott, late secretary of the Smithsonian Institution, on the stratigraphy of the Rockies, a motor truck expedition to the mountainous northwest has been dispatched from the institution The expedition is under the direction of Dr R S Bassler and Dr Charles E Resser Its first destination is Utah, whence it will work up through Montana to British Columbia

DR F G BANTING has left Toronto for Sydney, Nova Scotia, with the intention of accompanying the Canadian Government's annual Arctic expedition in the steamer *Beothic*, which is sailing for the Polar regions

PROFESSOR LEO E MELCHERS, head of the department of botany and plant pathology of the Kansas State Agricultural College, has been appointed by the Egyptian Ministry of Agriculture to do some special work in plant pathology for the Egyptian Government. He sails on September 3 from New York to Italy and then to Alexandria He will be on a leave of absence for a year.

DR E. P CHURCHILL, head of the department of zoology of the University of South Dakota, is in charge of a party making an ecological study of the fishes of South Dakota, the investigations this summer are to be concerned largely with the waters of the eastern half of the state

DR. LEO WOLMAN, lecturer at the New School for Social Research and economic adviser of the Amalgamated Clothing Workers of America, Dr Elwood Mead, agricultural expert of the United States Reclamation Service, and Professor Jacob G Lipman, of Rutgers University, will proceed shortly to Palestine to join the staff of experts there in a survey of the economic possibilities of the country

WE learn from the *Journal* of the American Medical Association that an expedition under the auspices of the University of Cincinnati has gone to Mexico to study the use, under clinical conditions, of an active vaccine treatment for typhoid, which Dr William B Wherry, professor of bacteriology and preventive medicine at the university, has given a preliminary trial on several cases of typhoid in Cincinnati In addition to Dr. Wherry, there is in the party Mrs Wherry, who is also a physician, Dr Thomas J Le Blanc, associate professor of preventive medicine; Dr. Lee Foshay, assistant professor of internal medicine, and Robert Thomas, a junior medical student The party sailed from New York on June 30, and will be in Mexico for about three months Arrangements have been made assuring the cooperation of the Mexican health officials

DR. ARTHUR M BANTA has returned to the Station for Experimental Evolution of the Carnegie Institution of Washington after a leave of absence for the spring quarter during which he gave a course of lectures at the University of Minnesota on genetics and eugenics He also gave some other lectures while at the university, including a short series of conferences before a group of geneticists and others on the "Genetics of Cladocera"

DR EDWARD J MENGE, head of the department of zoology at Marquette University, has sailed for South America, where he will make an extensive lecture tour for the next two and a half months Dr Menge has been invited to lecture at the three oldest universities on American soil, Lima, Peru, Cordova, Argentina, and Sucre, Bolivia, as well as at other universities He will speak on modern trends of biological work

SIR THOMAS OLIVER, the British authority on occupational diseases, will sail for the United States with Dr Frederick L Hoffman, from Cherbourg, on August 13 After a few days in Quebec and Montreal, he will leave for Boston and Wellesley Hills, proceeding later on a tour of inspection of industrial plants in Niagara Falls, Chicago, St Louis, Pittsburgh, Philadelphia, etc. Sir Thomas may possibly deliver several addresses on industrial problems while in the west He expects to be about four weeks in the country

DR HENRY MILLS HURD, emeritus professor of psychiatry at the Johns Hopkins University and until he resigned in 1911 superintendent of the Johns Hopkins Hospital, died on July 20, at the age of eighty-four years Dr. Hurd had been editor of *The American Journal of Insanity*, *The Johns Hopkins Bulletin*, *The Johns Hopkins Medical Reports* and *The Modern Hospital*

PROFESSOR CHARLES FULLER BAKER, formerly dean of the Agricultural College of the University of the Philippines, died on July 21, aged fifty-five years Professor Baker was the brother of Ray Stannard Baker, the author, and Hugh Potter Baker, the forester.

DR. ARTHUR A HAMERSCHLAG, president of the Research Corporation and previously director of the Carnegie Institute of Technology, died on June 30, in his sixty-fifth year.

WILLIAM PAUL GERHARD, consulting civil and sanitary engineer of New York City, died on July 8, aged seventy-two years

DR WILLIAM O KROHN, the alienist of Chicago, died on June 17, aged fifty-nine years

DR MAGNUS OLOF MITTAG-LEFFLER, until 1911 professor of mathematics in the University of Stockholm, died at Djursholm, Sweden, on July 11 Professor and Mrs Mittag-Leffler have bequeathed all their property, including the mathematical library and their estate at Djursholm, to an international mathematical institution, which has already been established and bears the name Makarna Mittag-Lefflers Matematiska Stiftelse

THE death is announced of Professor De Bruin, one of the foremost pediatricians in the Netherlands His principal works were studies on infantile scurvy and on cerebrospinal meningitis He was one of the founders of the Netherlands Pediatric Society

THE trustees of the Field Museum of Natural History have voted to dedicate the museum's Hall of African Mammals as the "Carl E Akeley Memorial Hall," in honor of the explorer, sculptor, inventor, taxidermist and founder of museum methods, who died in the Belgian Congo on November 27, 1926

SOME extra copies of the portrait of the late Arthur Bolles Lee, the author of "The Microtomist's Vade-Mecum," which was issued with the last number of the *Journal of Pathology and Bacteriology*, are available and may be had by any one interested on application to the editor at 17 Loom Lane, Radlett, Herts, England

THE sixth International Congress of the History of Medicine is being held at the University of Leiden and at Amsterdam from July 18 to 23 In Amsterdam there has been organized for the occasion an important exposition of paintings and books pertaining to anatomy and the art of healing

NEXT September will be held the triennial congress of the International Institute of Anthropology The Netherlands National Bureau of Anthropology, of which Dr Kleiweg de Zwaan is the president, is entrusted with the organization of the congress. At the same time, the International Federation of Eugenic Organizations will convene in Amsterdam The papers will be divided among the following sections (1) physical anthropology, (2) ethnography and ethnology, (3) heredity and eugenics, (4) sociology and criminology, (5) the prehistoric period and (6) folklore Dr Charles B Davenport, director of the Carnegie Laboratory for Experimental Evolution and of the Eugenics Record Office at Cold Spring Harbor, will speak on the crossing of races

THE British Association will meet at Leeds, for the third time, during the period August 31 to September 7 *Science Progress* writes as follows: "The first meeting took place in 1858, a few weeks after Wallace and Darwin had read their papers on the origin of species, and Sir Richard Owen's presidential address formed the opening note in the long controversy which has raged round that subject. In the twenty-two years which elapsed before the next meeting the Yorkshire College had achieved fame and two of its professors acted as sectional presidents The meeting this year will be the first since the college has developed into the University of Leeds It promises to be unusually interesting, and will be notable for the first appearance of a woman as sectional president Sir Arthur Keith, the president, has taken as the title of his address 'Darwin's Theory of Man's Descent as it stands To-day,' and Professor Whittaker, president of Section A, will deal with 'The Outstanding Problems of Relativity' The evening discourses will be given by Professor R A Millikan (Cosmic Rays) and Dr F A E Crew (The Germplasm and its Architecture) Among the discussions which have been arranged are those on 'The Structure and Formation of Colloidal Particles' and on the 'Climates of the Past' There will be the usual receptions, excursions to the Dale country, a garden party at Fox Hill (by the invitation of Colonel C H Tetley, pro-chancellor of the university) and special meetings for the discussion of textile problems"

A SERIES of lectures is being given at the Mount Desert Island Biological Laboratory as follows

July 18, Dr Harlow O Shapley, professor of astronomy, Harvard University, on "Concerning World Evolution", July 25, Dr. Edwin G Conklin, professor of zoology, Princeton University, on "Some Common Misconceptions regarding Evolution", August 1, Dr Herbert S Jennings, professor of zoology, the Johns Hopkins University, on "Biological Fallacies and Human Affairs", August 8, Dr. Roy W Miner, curator of invertebrates, The American Museum of Natural History, on "Exploring a Coral Reef from the Bottom of the Sea", August 28, Dr Kirtley M. Mather, professor of physical geography, Harvard University, on "Science and Religion—Friends and Enemies."

APPLICATIONS for associate physical chemist must be on file with the Civil Service Commission at Washington, D C, not later than August 9. The examination is to fill vacancies in the Bureau of Chemistry and Soils, Department of Agriculture, and in positions requiring similar qualifications The entrance salary in the departmental service at Washington, D. C., is $3,000 a year A probationary period of six months is required; advancement after that depends

upon individual efficiency, increased usefulness and the occurrence of vacancies in higher positions For appointment to the Field Service the salary will be approximately the same The duties in the Bureau of Chemistry and Soils will be to conduct research studies and technical investigations pertaining to fires in farm products, with special attention to spontaneous combustion and deterioration of hay, grain, cattle feeds and other agricultural products, and the development of methods for their control and prevention Competitors will not be required to report for examination at any place, but will be rated on their education, training and experience, and a publication or thesis to be filed with the application

Industrial and Engineering Chemistry reports that representatives from the Museum of the Peaceful Arts of New York City and from the Smithsonian Institution of Washington, D C, of which the National Museum of Engineering and Industry will be a part, recently attended a luncheon in connection with the annual meeting of the latter organization The intimation was given that owing to changes which were contemplated in the plans of the Mall in Washington by the Commission of Fine Arts of that city, there possibly would be a change in the location of the site of the museum building on the Smithsonian grounds At a subsequent meeting of the commission attended by representatives of the Smithsonian Institution and the National Museum, a new site satisfactory to all the parties interested was agreed upon At the meeting after the luncheon above referred to, officers and trustees for the current year were unanimously elected as follows: *President,* Thomas Ewing, former commissioner of patents, *Secretary,* Harrison W Craver, director, United Engineering Societies Library, *Trustees,* L P Alford, B C Batcheller, George M Bond, Nicholas F Brady, Ericsson F Bushnell, Fred H Colvin, F A Halsey, Thomas T Hoopes, D C. Jackson, Joseph Keller, Fred R Low, H P Merriam, H F J Porter, Dr M. I Pupin, Dr Elmer A Sperry, Kirby Thomas and F A Waldron.

THE Associated Press reported on July 13 the lake of lava from Kilauea crater, which began an eruption on July 7, was at that time steadily building to new levels on the floor of the eight-mile-wide Halemaumau pit as the lava from the cones spreads in spirals about the hardening surface The principal cone, as the tube of hardened lava about each center of eruption is called, is about fifty feet high It is continually capped with a layer of rock which hardens from its molten state, except for the periodic outbreaks when the accumulated pressure from the subterranean forces thrusts itself through and sends out a fiery fountain. The flow of other fountains below the surface of the lake which covers more than 100 acres on the floor of the Halemaumau pit can be plainly seen by the motion of the crust, which occasionally breaks to permit new flows to spread R M Wilson, volcanologist, predicts that the lava lake will gradually rise until the fifty-foot cone is submerged, after which the flow of lava will continue beneath the surface The flow yesterday was as strong as at any time since the eruption began

UNIVERSITY AND EDUCATIONAL NOTES

PLANS are in preparation for a laboratory of physics to be built for the Johns Hopkins University at a cost of $350,000

THE Sheffield Scientific School of Yale University has received by the will of Chester W Lyman, formerly president of the International Paper Company, the sum of $50,000, to be used in teaching hydraulic engineering and allied subjects

DR HARRY YANDELL BENEDICT, professor of applied mathematics and dean of the college of arts at the University of Texas, has been elected to succeed Dr Walter Splawn as president of the university

DR. ROLLIN T WOODYATT, of the University of Chicago, has been made chairman of the department of medicine

PROFESSOR EDWIN D STARBUCK has been appointed head of the department of philosophy at the State University of Iowa Philosophy and psychology, which have existed as a single department, are now separated Professor Starbuck has also been officially made director of the Institute of Character Research which has hitherto been known as the Research Station in Character Education The institute has received a special appropriation from the state legislature

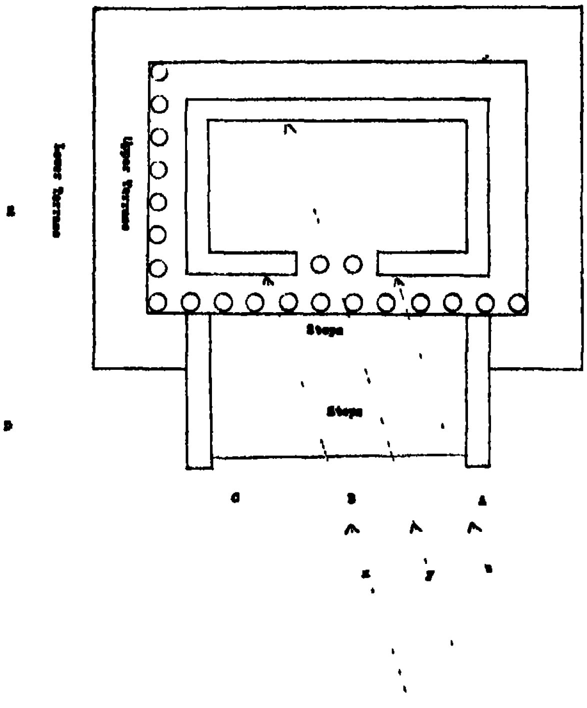
DR. IRVING W. BAILEY, associate professor of forestry at Harvard University, has been appointed professor of plant anatomy

DISCUSSION AND CORRESPONDENCE

THE VARIABLE ECHOES PRODUCED BY THE LINCOLN MEMORIAL

ON the evening of June 11 during a display of fireworks on the executive grounds in Washington, the writer's attention was drawn to the peculiar echoes produced by the scattering of sound waves against the outer and inner walls and the fluted columns of the Lincoln Memorial. In the accompanying diagram the direction of the sound waves, from a source

three quarters of a mile distant, is indicated by the dotted arrowed lines x, y, z. In the position A, at the bottom of the main steps of the approach, no echo was apparent. But as the observer approached



the point B a faint weird echo of high pitch began to be heard after each report of the exploding fireworks As the observer continued towards the point C the intensity of the echo increased, its tone being of a shrill metallic quality, somewhat prolonged and resembling the sound produced by a file when drawn across the teeth of a saw As one proceeded around the corner of the memorial towards the point D on the lower terrace the echo gradually changed to a lower pitch of more prolonged duration, the sound at this place resembling the sharp tearing noise produced by ripping a piece of cloth As one passed onward towards the rear of the memorial the echo grew constantly fainter and ceased entirely at about the point E.

C A Browne

THE LUNELL HERBARIUM

Botanists interested in the taxonomy of the flowering plants have long been familiar with specimens collected by J. Lunell, of Leeds, North Dakota

Born in one of the well-known castles of Sweden, in 1851, where his father was rector, Dr. Lunell emigrated to the United States at about 37 years of age, bringing with him the responsibility for a family of three children

After a year devoted to the practice of medicine in St. Paul, he felt the irresistible call of the frontier and took up his work at Willow City, North Dakota, in 1889, at a time when cities were but names which expressed the hopefulness and ambition of those who were living in dugouts, sod houses or board and tar paper shelters. He remained there for about five years before taking up his permanent residence at Leeds, North Dakota From the first moment of his arrival he began to collect and study the plants of the region As a student, his leisure time had been devoted to the collection of plants, all of which were left behind when he came to the United States Demands for the services of the one doctor often crowded out eating and sleep, but if the long outgoing journeys permitted no opportunities for delay, the return trips always afforded a means for noting and collecting plants of particular interest It is a great misfortune that there were not more such men to study and preserve for future reference actual specimens of a flora which has now largely disappeared through the ravages of fire and the inroads of agriculture.

While Dr. Lunell is known widely to taxonomists through his collections, and his systematic botanical notes and papers, perhaps few are aware that he was a man of highly varied interests Graduated from the University of Upsala, he read Latin, Greek and Hebrew as well as the modern languages Before coming to America, in addition to the translation of technical writings, he had made some of the writings of Mark Twain, Marryat, Savarin and other French and Russian authors available to those whose reading was limited to the Swedish language. His volumes of classical music, well worn by use at his own piano, were about as numerous as the bound botanical works of his small library

Since Dr. Lunell's death, at sixty-nine years of age, in 1920, his herbarium has been little used by botanists. It is unfortunate that there is not now more local interest in collections of the plants and animals of the various regions of the United States, but until such local interest exists, it is desirable that collections of this kind, made by those when fired with enthusiasm for scientific work, even under difficult conditions, be ultimately assembled in centers where they can be available to students.

Students of the flowering plants will be interested to know that the Lunell herbarium has been purchased by the board of regents of the University of Minnesota for the department of botany. In the course of a few months, the materials will be incorporated in the herbarium and there be available to students who may wish to use them.

J. Arthur Harris

INDEX KEWENSIS

I UNDERSTAND that it is not generally known that the sixth supplement of the Index Kewensis was published last year by the Clarendon Press This includes references to the names and synonyms of genera and species of flowering plants which were published during the five years 1916–1920, and also includes many which had appeared in previous years in publications which, owing to the war, were not available at Kew

The Index Kewensis is an indispensable work to all plant systematists, whether botanists or horticulturists, who desire to keep abreast of botanical nomenclature The original index we owe to the generosity of Charles Darwin and six quinquennial supplements have now been published Some idea of the labor involved in keeping up this record may be gathered from the fact that the sixth supplement recently published contains some 30,000 references

With such increases in the number of new species and binomials, especially in such genera as Rosa, Rubus and Hieracium, the work of the systematist would be almost impossible without this periodic gathering together of the newly minted currencies in the world's botanical nomenclature

As I have been informed that many sets of the Index Kewensis in botanical and horticultural libraries appear to be incomplete, and that in some cases supplements have been purchased for libraries which do not possess the original volumes, I have been asked to direct attention to the importance of the work I would also point out that it is necessary, in order to keep abreast of botanical nomenclature, to possess all the supplements which have been published as well as the original index.

Copies of the original index or of any of the six quinquennial supplements may be obtained from the secretary, The Clarendon Press

ARTHUR W. HILL

THE USE OF THE GENERIC NAME WILSONIA

IT has recently been called to the writer's attention that there exists a duplication of the generic name *Wilsonia*. Priority of use seems to rest with Bonaparte's genus of wood warblers described on page 23, "Geographic and Comparative List of Birds, 1823" (cited by Ridgway, page 703, United States National Museum Bulletin 50, Part 2). In 1873 Keyser applied the name to a brachiopod previously called *Terebratula wilsoni* Sowerby. Keyser's description may be found on page 502, Volume 23, *Zeitschrift der Deutschen Geologischen Gesellschaft*, 1873 Rules of nomenclature, therefore, seem to demand that the name be reserved for the avian genus, and it is suggested that the next available name, *Uncinulina*, used by Bayle for the same form on Plate 13, figures 13–16, "Explication de la Carte France, Atlas," Volume IV, 1878, be used to replace the genus *Wilsonia* among the brachiopods

W. C TOEPELMAN

UNIVERSITY OF COLORADO

A NOTE ON THE HISTORY OF ANTHROPOLOGY

SEVERAL inexplicable errors occur in the opening paragraph of President Henry Fairfield Osborn's paper on "Recent Discoveries relating to the Origin and Antiquity of Man" (SCIENCE, 65 (1927), 481) The "renowned Hans Virchow" is represented as opposing "the recognition of the Neanderthal skull of 1846 with pathologic and theologic preconceptions" The great pathologist's name was not Hans, but Rudolf, the Neanderthal skull was not discovered until 1856,[1] and any one acquainted with the psychology of that most tough-minded of scientists can only express a hope that all writers on the origin of man were as free from theological preconceptions as Virchow It is true that theologically inclined writers were fond of citing Virchow's authority against Darwin, but his own position in the matter was skeptical to the point of negativism, not tinctured with any form of religious bias

ROBERT H LOWIE

PROFESSORSHIPS IN MEDICAL SCHOOLS

IN the number of SCIENCE for July 15 I note in the delightful sketch of Dr. Franklin P Mall, written by Dr. William T Councilman, the statement that "all the teaching positions in medical schools throughout the country, with the exception of the chair of physiology at Harvard, were held by men who were active practitioners of medicine as well, and the professorial positions were regarded as valuable adjuncts to a medical practice."

The time referred to, I take it, is the early '80's. I would like to call attention to the fact that certainly since 1831 the occupants of the chair of anatomy in the school of medicine of the University of Pennsylvania have not been practitioners of medicine, and that certainly from 1818 and possibly earlier, this also holds true for the professors of chemistry in the same school. Certainly Leidy, who held the chair of anatomy from 1853 to 1891, and Theodore G Wormley, who held the chair of chemistry and toxicology from 1877 to 1897, devoted their entire time to teaching and research

WILLIAM PEPPER

[1] H. F. Osborn, "Men of the Old Stone Age," 3rd edition 1918, 217.

QUOTATIONS

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

NEARLY a quarter of a century ago, on January 19, 1903, a small group of scientific investigators in New York met at the call of Professor Graham Lusk and the late Dr S J Meltzer to consider the organization of active workers in experimental biology and medicine This was the meeting that initiated the Society for Experimental Biology and Medicine under the presidency of Dr Meltzer The main object of the organization was the cultivation of the experimental method of investigation in the sciences of experimental biology and medicine Membership in the group was limited to persons who had completed some meritorious independent experimental research in that field of study The programs, from the start, consisted in brief presentations of the essential features of experimental investigations, and frequently of demonstrations of actual experiments The membership soon outgrew its confinement to "Greater New York" and spread throughout the country One reason for the success that has attended the development of this society lies perhaps in the significant circumstance that it has aimed to bring together workers in many fields, such as physiology, biochemistry, biology, bacteriology, pharmacology and experimental medicine, at a time when rapidly developing specialization had already begun to segregate investigators into small groups The new society thus represented a wholesome reintegrating force and provided a stimulus for the discussion of "borderline" and interrelated problems It has become an influence tending to overcome the danger of narrowness in the present-day outlook on the natural sciences with which medicine is so closely bound up Another early object of the society was the development of high standards of presentation and scientific criticism Incidentally, not a few significant discoveries have been announced for the first time at its meetings As might be expected, this movement was bound to be followed by similar endeavors elsewhere Many of them have resulted in the organization of branches of the society To-day ten branches are located all the way from New York to Peking, eight more are at present under contemplation The contributions, in the form of brief, concise summaries, are embodied in the *Proceedings of the Society for Experimental Biology and Medicine*, which is available through subscription This journal deserves the active support of members of the medical profession, who are likely to find it stimulating and informative Published without special endowment and maintained by the contributions of scientific workers, it needs and enlists the help of those who can benefit by its program.—*The Journal of the American Medical Association*

MUSCLE, YEAST AND CANCER CELLS

IN his comparative study on the carbohydrates and gaseous metabolism of isolated muscle, at rest and at work, Otto Meyerhof[1 2] finally established beyond all doubt the doctrine that utilization of oxygen by muscle takes place normally, not during the act of contraction but rather during the periods of relaxation and rest immediately following It was further shown that the energy required for contraction is directly derived from the breakdown of glycogen into lactic acid, whereas during the recovery period the oxidation involves a twofold action, the burning of one part of sugar, or its lactic acid equivalent, to carbon dioxide and water, while three to six times the amount of lactic acid is built back to glycogen In other words, the immediate source of the energy for contraction is gotten by an anaerobic reaction, while the recovery from the contraction in its normal and most efficient manner is accomplished by an aerobic chain of reactions which culminates in the saving of a large part of the carbohydrate that had been split during the anaerobic phase or the contraction period A further study revealed the fact that the processes found to hold for muscle in action also take place during periods of complete normal rest, although with much less intensity, so that the resting level of lactic acid concentration, from 0 015 to 0 03 per cent of the muscle's weight, represents not only the residue of a previous recovery period but also the continuous balance sheet of a never-ceasing anoxidative carbohydrate splitting and an equally continuous oxidative removal of the split bodies by the twofold process of one part burned to carbon dioxide and water and from three to six parts built back to glycogen

It is obvious that the anoxidative phase of these events is an expensive, prodigal one, but one apparently capable of yielding quickly and abundantly the free energy that is needed to enable the muscle cells to raise tension and to contract as quickly as they do, whereas the oxidative phase is one that not only frees the cells of the split products that accumulate during the anoxidative phase, clearing the decks for the next action, as it were, but does it in the manner of a salvager, rescuing at the same time as much of

[1] Meyerhof, O, "Die Energie Umwandlungen im Muskel," *Arch f d ges Physiol*, *182*. 232, 284 and *185*. 11, 1920, *188* 114, and *191*: 125, 1921; *195*. 22, 1922; Meyerhof, Lohmann, u Meier, "Synthese des Kohlehydrats im Muskel," *Biochem. Zeitschr*, *157*: 459, 1925

[2] Hill, A. V, u Meyerhof, O., "Über die Vorgänge bei der Muskelkontraktion," *Ergeb d Physiol.*, *22*. 299, 1923 (This joint review should be consulted for earlier literature and contributary evidence.)

the material as may be for future use. It will be noted that the breathing of the muscle cells is bound up with the aerobic phase only. Since the anaerobic splitting depends upon the action of ferments, this phase has been referred to as the phase of fermentative breakdown, the aerobic is often referred to as simply the respiratory phase

With this cycle of alternating fermentative breakdown and respiratory recovery established for the skeletal muscle cell, the question arose as to whether the phenomena involved represented properties peculiar only to muscle or whether they were properties of other living cells as well.

Since the work of Pasteur the so-called anaerobic character of certain organisms has been known. Certain varieties of the yeast plant thrive amazingly well in the absence of air Indeed the bottom wirts of the highly cultivated beer and vinous yeasts have been regarded as utilizing no oxygen whatever The energy for growth in these cases is obviously derived from the anoxidative splitting of higher carbon compounds to carbon compounds of lesser complexity On the other hand, yeasts such as the press-yeast, bakers' yeast and the wild yeasts continue to grow in the presence of oxygen, although their fermentation capacity at the same time is reduced The problem of the part played by oxygen in the growth and fermentative action of yeast therefore had been recognized and studied not only by the more modern students of fermentation but also by Pasteur But as Meyerhof points out, a definitive answer to the question could not have been obtained by the use of the cruder methods these workers had at their disposal, an employment of the more modern methods of micro-analysis such as were used in the study of muscle metabolism, however, ought to yield a less conflicting body of data Such an application Meyerhof and his associates[3] have now made to the study of a number of various fermentation bacteria

In these studies it is shown that even in the cases of the so-called anaerobic forms there is an actual utilization of oxygen, although small in amount, whenever this gas is admitted to the wirt in proper media. But however small or large the amount of oxygen utilization is, whether the form studied is of the "aerobic" press-yeast or bakers' yeast, or whether the form is of the "anaerobic" races, for example, the bottom wirt of beer and vinous yeasts, the same two processes of metabolism found for muscle cells are here also found One process, the anoxidative, concerns itself with the fermentative breakdown of carbohydrate into ethyl alcohol, pyruvinic acid, acetaldehyde, lactic acid, acetic acid, etc, the other process, the oxidative, concerns itself with the complete oxidation of a part of the carbohydrate and the rescuing of another part from the fermentative breakdown But more than this, when the ratio of the total number of molecules of split products removed to the number of molecules oxidized is determined for the various forms of bacteria, the oxidative quotient, as it is called, is shown to be of the same magnitudes as were found in the case of muscle, that is, between 3 and 6 In other words, for every molecule of carbohydrate oxidized to carbon dioxide and water 3 to 6 molecules are rescued from the fermentative breakdown This, then, explains why the amount of fermentation products is less when oxygen is admitted to fermenting yeasts, and at the same time demonstrates that fermentation bacteria are only different from muscle in their metabolism chiefly *in that the two major processes of metabolism* have each undergone transformation (Umstimmung), the fermentative process having been greatly augmented, the oxidative salvaging process having been greatly depressed or partly lost

As to how this transformation may have come about has been largely answered by both O Warburg and O Meyerhof and their associates in a series of independent studies It was found by the latter[4] that so little as .0002 normal hydrocyanic acid present in the media of aerobic races of yeast reduced their oxidative power nearly 90 per cent., but their anoxidative fermentative power only as little as 10 per cent., and that by successive cultures these yeasts so transformed would produce permanent anaerobic strains of the plants On the other hand, by treating anaerobic races with substances that stimulate their breathing capacity, permanent strains of aerobic plants could be cultivated With increased utilization of oxygen increased salvage of carbohydrate was ensured and thus a corresponding decrease in the apparent fermentative splitting resulted

Preceding and contemporary with these investigations on yeast two series of studies, one by O Meyerhof and his coworkers,[5] the other by O Warburg

[3] Meyerhof, O, "Über den Einfluss des Sauerstoffs auf die alkoholische Gärung der Hefe," *Biochem. Zeitschr*, *162* 43, 1925; and *Die Naturwissenschaften*, Jahrg 14, p 1175 (Dec.), 1926; also, Meyerhof und Finkle, "Über Berziehungen des Sauerstoffs zur bakteriellen Milchsäure gärung," *Chem. d Zelle u Gewebe, 12*: 157, 1926

[4] Meyerhof, O, "Über den Einfluss des Sauerstoffs auf die alkoholische Gärung der Hefe," *Die Naturwissenschaften*, Jahrg 13, p 980 (Dec 4), 1925, "Über den Zusammenhang der Spaltungsvorgänge mit der Atmung in der Zelle," *Ber d deutschen chem. Gesellsch*, Jahrg 58, p 991, May, 1925

[5] Meyerhof u. Lohmann, "Über Atmung und Kohlehydratsumsatz tierischer Gewebe," *Biochem Zeitschr.*, *171*: 381, 421, 1926, B Takane, *ibid*, *171* 403, 1926

and his coworkers,[6] demonstrated that the two metabolic processes, anoxidative-fermentative-splitting and oxidative-salvaging of the split carbohydrate, were characteristics of animal tissue cells other than muscle, and especially of growing tissues, such as mucous membrane, skin and glandular tissues, and curiously enough also of retinal tissue All embryonic tissue showed a high rate of both the fermentative splitting and the oxidative salvaging processes.

When pathologic cells, such as carcinoma cells, were studied by Warburg and his associates, the remarkable facts were revealed that these cells exhibited an excessively high rate of fermentation, causing a vastly greater amount of sugar to be split to lactic acid than normal cells do, but on the other hand a greatly diminished power of utilizing oxygen Indeed it was found that cancer cells could live and continue to split sugar in a nutrient solution in which the pressure of the oxygen had been reduced to 1/100000 vol per cent, the cells could live and recover completely if asphyxiated thus as long as forty-eight hours Longer asphyxiation, however, proved to be fatal It was shown that they utilized oxygen in small amount independently of high tension of the gas. That is, the oxygen utilization as in normal cells appears to be determined only by the physiological capacity to breathe. The high rate at which tumor cells are capable of splitting dextrose to lactic acid is shown by the fact that *in vitro*, in an hour, they can produce an amount of lactic acid equal to 10 per cent of their own weight. It is emphasized that in these quantitative studies the weight of tumor cells always refers to masses of pure tumor cells and not the usual mixtures of tumor and non-pathological cells that are removed by the excisions of the surgeon Experiments testing the blood passing into and that passing out of a tumor in the living animal supports the results obtained *in vitro* The blood from a tumor vein is found in rats to have two to three times as much lactic acid as that from an artery

These physiological experiments with normal and pathologic animal cells when compared with those on muscle and yeast show, as the authors point out,[4, 6] that there is a striking similarity in the physiological transformation that tissue cells must undergo to become tumor cells on the one hand, and that the aerobic yeasts must undergo to become the anaerobic type on the other That normal embryonic cells may be transformed into cancer cells by injury *in vitro* (arsenic and other poisons) has been shown by Carrel and by A Fischer. The cells so injured when injected into chickens developed sarcomas. The injury in these cases consisted first in damaging the respiratory function of the cells, but being embryonic cells they already had their fermentation capacity highly developed When injected into normal animals the cells were able to thrive by continuing their anaerobic fermentation, their supply of sugar being furnished by the host That they could utilize little oxygen was rather an advantage than a disadvantage to them. Warburg points out that these results confirm the view long held that cancers are the result of injury to normally growing cells and that the injurious agent may be of manifold variety

It would seem that the next step in the field of cancer research is to find out if possible how the cancer cell can be transformed back to the normal cell; how it may most easily be trained to improve its breathing capacity, and if possible to reduce its fermentative capacity If such retransformation can be effected metastases would be rendered much more unlikely, for during the early stages of fixation comparative oxygen-want and diminished ability to get energy from anaerobic fermentative carbohydrate splitting would more likely lead to the death of the cells Surgical removal of parent tumors then would mean more certain the removal of all the tumor-producing tissue, and in cases of the inoperable kind one could still hope to check the growth

C D SNYDER

THE JOHNS HOPKINS UNIVERSITY

[6] Warburg, Posener, u Negelein, "Über den Stoffwechsel der Carcinomzelle," *Biochem Zeitschr*, *152*. 309, 1924, Warburg, "Über den heutigen Stand des Carcinomproblems," *Die Naturwissenschaften*, Jahrg 15, p 1 (Jan 7), 1927

SPECIAL ARTICLES

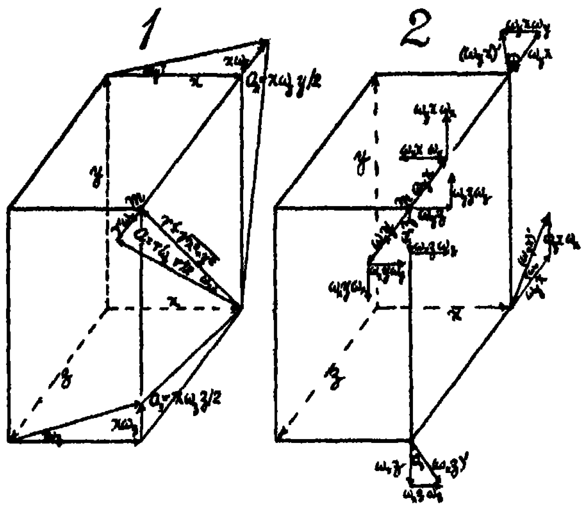
GRAPHIC TREATMENT OF EULER'S EQUATIONS

I WAS struck, some time ago, with the ease with which the familiar Eulerian tensor ($A = \Sigma m(y^2 + z^2)$, etc, $D = \Sigma myz$, etc)

$$\begin{matrix} A & -F & -E \\ -F & B & -D \\ -E & -D & C \end{matrix}$$

usually reached analytically, can be written down from the mere inspection of an orthogonal volume. The angular momentum (H), the kinetic energy (T) and the torque of centrifugal forces (C) of a rotating rigid body are all in question, the last two taking the vector form $2T = \mathrm{H}.\mathrm{w}$ and $\mathrm{C} = \mathrm{H} \times \mathrm{w}$, w being the vector angular velocity.

H.—In Figure 1 let m be any molecule of the body rotating clockwise about the x, y, z axes and for convenience let the unit of time be infinitely small so that w may be infinitesimal. The figure shows the component angular velocities ω_x, ω_y, ω_z, the corresponding tangential velocities $\omega_x r'$, $\omega_y x$, $\omega_z x$ and the



momentum couples per unit of m $2a_1 = r'\omega_x\ r'$, $2a_2 = -x\omega_y\ y$, $2a_3 = -x\omega_z\ z$, where $r' = \sqrt{y^2+z^2}$ so far as displacements in a plane normal to x are concerned If therefore we make the summation for all the mass points m of the body, w being constant, we obtain the coefficients $A - F - E$ of the first row of the tensor and the component moment of momentum about the x axis, $A\omega_x - F\omega_y - E\omega_z$ The forces normal to y and normal to z contribute the other two, in turn

H W—If this angular momentum about x be construed as linear momentum relative to a radius 1 and if it be multiplied by the angular velocity ω_x also regarded as linear for the same unit radius, the product $(A\omega_x - F\omega_y - E\omega_z)\omega_x$ is twice the kinetic energy of the body, so far as rotation about x is concerned The other two axes make the corresponding contributions. The expression is interesting in showing how square product terms arise in the equation for kinetic energy

H × w—In contrast to the preceding, the equation for the torque of the centrifugal forces is astonishingly complicated. I have analyzed it in Figure 2, to be interpreted in the same way as Figure 1, but referring to the torque about the z axis. Centripetal force is generated by the rotation of a tangential velocity about a non-parallel axis (a few examples at the corners of Figure 2) and acts at m with the appropriate lever arm here either x or y The tangential velocities $\omega_z y$ and $\omega_z x$ may be discarded; for either they are not rotated $(\omega_z y\ \omega_x$, $\omega_z x\ \omega_y)$, or they generate pulls along z, $\omega_z y\ \omega_y$, $\omega_z x\ \omega_x)$, while the torques $\omega_z x\ \omega_z\ y$ and $-\omega_z y\ \omega_z\ x$ balance Since $\omega_x x$, $\omega_y y$, $\omega_z z$ have no meaning, there remain so far as m alone is concerned, the tangential velocities (see Figure 2)

$$\omega_y x,\ \omega_x y,\ \omega_y z,\ \omega_x z$$

The per second rotation of these produce the centripetal forces per gram of m (see figure)

$$-\omega_y x\ \ \omega_x + \omega_x y\ \ \omega_x - \omega_y z\ \ \omega_z$$
$$-\omega_y x\ \ \omega_y + \omega_x y\ \ \omega_y + \omega_x z\ \ \omega_z$$

which operate respectively with the lever arms x and y, so that the full torque about z is

$$m\,(-\omega_y x\ \ \omega_x + \omega_x y\ \ \omega_x - \omega_y z\ \ \omega_z)\,x - m\,(-\omega_y x\ \ \omega_y + \omega_x y\ \ \omega_y + \omega_x z\ \ \omega_z)\,y$$

To convert it into torque of centrifugal forces, these must be reversed. For symmetry $m\omega_y\,\omega_x z^2$ is to be added and subtracted, to match the terms in x^2 and y^2 Finally the summation is to be made for all the points m of the body. The result (after arrangement) is for the axis z,

$$(A-B)\omega_x\omega_y + F(\omega_x^2 - \omega_y^2) + (D\omega_x - E\omega_y)\omega_z$$

with corresponding expressions for the x and y axis. Altogether therefore there are 18 deputy torturers engaged in their nefarious practices Naturally if D, E, F, vanish, the treatment by the same method is simple.

CARL BARUS

BROWN UNIVERSITY,
PROVIDENCE, R I

THE SEAT OF FORMATION OF AMINO ACIDS IN PYRUS MALUS L.[1]

ALTHOUGH it has been established that nitrates can be reduced to nitrites in the roots and stems of plants, the possibility that the reduction of nitrites to form α-amino acids as an intermediate stage in the synthesis of proteins in plants could also take place in the cells of the roots and stems has not generally been accepted Emmerling[2] indicated that in certain soils amino acids might be formed from nitrates in the roots and stems of some plants However, Sachs (1865), Sorokin (1870), Pagnourd (1879) and Schimper[3] (1885) supported the photochemical theory of the formation of amino acids and proteins They considered the chloroplast of the cells of the leaves maintained with a continuous supply of carbohydrates as being specially adapted to carry on the synthesis of proteins from ammonium salts and nitrates supplied to them by the conducting cells Moreover, the rapid consumption of nitrates in the leaves is offered as the reason for the lower nitrate content in these tissues than in the roots and stems of some plants

[1] Published by permission of the Director of the Agricultural Experiment Station as Technical Paper No 425 Contribution No. 28 of the Department of Agricultural and Biological Chemistry

[2] Emmerling, A, numerous papers in Landw Ver Stat (1880–1898)

[3] See Czapek, F, Biochem der Pflanzen 2 pp 296–301 (1920) for a résumé

This view that the synthesis of amino acids can take place in the leaves only has been especially emphasized more recently by Baly and his colleagues[4] from their experiments on the reduction of nitrates *in vitro* It is maintained by these investigators that the activated formaldehyde $\mathrm{H\,C}\begin{smallmatrix}/\!/\mathrm{O}\\ \diagdown\mathrm{H}\end{smallmatrix}$ produced photosynthetically in the living chloroplast cells reacts upon the first product of reduction (the nitrous acid salt—KNO_2) giving rise to formhydroxamic acid $\mathrm{H{-}\underset{\displaystyle NH}{\underset{|}{C}}{-}OH}$, the formation of which was first established by Baudisch[5] by exposing a solution KNO_2 and methyl alcohol to ultra-violet light. This latter is assumed by Baly and his colleagues to react with another molecule of activated formaldehyde, giving rise to numerous nitrogen compounds such as, for example, the α-amino acid—glycine It follows, they claim, that the synthesis of nitrogen compounds *must* be restricted to the leaves Although these papers have attracted considerable attention, plant physiologists have necessarily been cautious in accepting the conclusions drawn

Thus, Dr Eckerson[6] has shown that the hypothesis propounded by Baly *et al* that nitrates are reduced in the light by activated formaldehyde in green leaves is inapplicable to the results of her experiments on tomato plants having a high C N ratio, since, in this case, when nitrates are fed, it is the fructose and glucose that are oxidized, accompanied by an hydrolysis of starch as the hexoses are used up in the formation of amino acids and a portion possibly in increased respiration Suzuki[7] also obtained strong nitrate tests with barley plants fed nitrate only, the nitrate disappearing when sugar was added The nature of the active material is unknown Anderson[8] has postulated the presence of a reducing substance resembling the atite of Haas and Hill[9]

During the investigations of the writer, extending over the past four years, on the nitrogen metabolism of Pyrus Malus, in which the partition of nitrogen has been studied in the various parts throughout a year's cycle, positive tests were found for nitrates (or nitrites) in one tissue only and this at just one period of the year, *viz*, in the leaf buds just as they were opening. This work was carried out on mature and seedling apple trees receiving heavy applications of sodium nitrate at regular intervals throughout the vegetative period, by means of microchemical tests on sections of the leaves, tips of stems and one and two-year old branches with diphenylamine reagent,[10] "G" salt,[11] and the Griess-Ilosvay Reagent,[10] and also numerous *quantitative* tests[12,13,14] on both the dialyzed and undialyzed sap, preserved under toluene, and on aqueous alcoholic extracts of various tissues during the vegetative cycle. The fine roots gave nitrate reactions throughout the season, whereas in the main roots the reaction was much feebler and, as already stated, the tests were negative in the aerial parts except in the buds as they were opening Correspondingly, quantitative tests for amino acids were always higher in the roots than in the aerial parts

These results are in accord with the recent work of Dr Eckerson,[15] who found that the reducing power of extracts from various parts of apple trees collected last September and November showed decided differences The fine roots were very high in reducing activity, the buds less active and the bark of first and second year twigs had very little reducing power

From the foregoing, it can scarcely be doubted that in this species the reduction of nitrates to amino acids takes place for the most part in the roots Although experiments *in vitro* may be valuable in suggesting types of reactions that may occur in the cells of plants or animals, the extension of the results of such experiments as indicating the actual conditions existing to the processes *in vivo* should be made with caution The internal conditions existing in the plant at any one time may bring about unlike chemical reactions to accomplish the synthesis of α-amino acids and the different plant species may not carry out these syntheses in the same way. These investigations do not throw any light on the mechanism of the formation of amino acids in this plant and any suggestions offered at present would be purely hypothetical.

WALTER THOMAS

DEPARTMENT OF AGRICULTURAL AND BIOLOGICAL CHEMISTRY, PENNSYLVANIA STATE COLLEGE

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RESEARCH[1]

MAN'S search for information about his surroundings and about himself is as old as the race. He has been conscious of it since thought began Only in degree, in precision, has our search changed in all the ages, now, in designating a very careful, very logical, extremely critical phase of this feature of our intellectual life we have come to use the word research

A dog searches for a bone led by his senses and experience, influenced little, if at all, by what he has of reasoning ability The morphologist searches for the reasons underlying the shape of the bone, the physiologist examines into its functions—both search with the aid of their highly developed reasoning powers, and their work we call research.

Whatever the details of the special case, research is a mental process superimposed upon the observation of facts It is mechanical as well as rational, the two functions being equally important. Because it is a human activity it may be judged in terms of its usefulness as against its cost, cost being interpreted as human effort rather than as mere money expended However, being wide enough to embrace the infinite multitude of observable facts, whether these are found under natural conditions or as the result of the artificial conditions we call experiment, and also being a product of the trained imagination whose every guess is legitimate if in harmony with the facts, research is not easily reduced to analysis. How is it possible to place a value on a product as intangible as a work of art? How can we say whether the effort that went to the making of it is justified or wasted? It is no easier to judge the value of the products of the play of the imagination on the facts of existence It is perhaps still harder to judge the value of the effort that goes to the collection of a mass of minute facts, each trivial as the hammering of a nail into a plank, yet each contributing to knowledge It is much easier to judge of visible products, thus, when the architect and the artisan are finished, the result of the interplay of imagination and detail stands before us and we can judge it according to our likes and dislikes, of our feeling of its fitness to fulfill its purpose as measured against its cost.

Because of its illusiveness, because of the enormous prizes it has brought to mankind, because of its value

[1] Presented at a joint meeting of the Rhode Island Sections of the American Chemical Society and the American Association of Textile Chemists and Colorists

as a mental training, there is a tendency to be slipshod in criticizing research Research is such an honest effort to achieve something of value that we are apt to condone the futility because of the good intention, or we may err the other way and condemn what is intangible because we can not measure its use

I propose to you that together we examine the modes and the cost of research and see if we can not reach some conclusion regarding the enterprise as a function of human society Research for our purpose is organized effort to acquire knowledge regarding natural phenomena If we consider the research going forward in this country, we can divide it roughly into four groups, that carried out as a part of the intellectual program of institutes of learning, which we may call academic research simply because of its home, not because of its character Next we may place together the activities of institutions founded especially to advance our knowledge by research The work done in the industries we shall take for our third group and, finally, we shall make a fourth classification which we shall call professional research.

In all this work the effort can be classified in this way materials and energy used, which includes the cost of the surroundings in which the research is carried out, of the equipment and of the energy consumed in the shape of heat, light and power. The man power—this involves not only the thinking brain conducting the research, but also the manipulative functions of the research man or those assisting him in the research This would include what the industrialist calls executive overhead as well as labor assistants Time, as a function of research, is really important, especially in the industrial field and should be considered in connection with all research.

Academic research has been the fountain from which the most important knowledge regarding our surroundings has come. There was a time when research was unknown outside the walls of the institute of learning or the private home of the learned man Now-a-days the quantity of academic work is greater than ever before, and I think that we are not critical enough of it. Let us consider first of all the cost of research, which is obviously the most easily measured factor In industry, where the cost of doing anything is checked very closely, it has been found that a trained research man whose salary is about $300 per month requires materials and man-power assistants costing $450 per month at least That is to say, the research cost per hour, assuming a 200-hour month, is $4 00 The work done in the university costs less because, in view of the fact that the student doing his research gains by learning how he should approach a problem, he is paid nothing for the time he puts in, although he may work his way through by teaching part time for which he is paid. Assuming, and I think this is not assuming too much, that the incidentals cost just as much in academic work as they do in the industries, that is, the working space properly furnished, heated and lighted, the laboratory facilities, the administrative expenses, the time of the man assisting the student, we reach a figure of approximately $2 25 per hour, plus the effort of the worker. It a doctor's thesis takes 2 years of 9 months a year and the research occupies the candidate 8 hours a day during the academic year, then we reach a figure of $6,480 as the cost of a doctor's thesis Multiply this by the number of researches of this kind being carried out and we find that the people of the country are spending millions of dollars on academic research of this type alone Any industrial firm spending such an enormous sum would be highly critical of the results obtained

I suggest that academic research is not properly scrutinized We regard it so much as one of the steps in the course perfecting a student that we are apt to ignore its intrinsic value Now I am not going to argue that the training the student gets is not of primary consideration, although I think that it is less important than it is sometimes thought. I am also willing to concede that the student is doing his first research work and is therefore much less competent than the older research worker of the industry, yet when everything is taken into account it seems to me that we could get very much more from the work than we do

A destructive criticism is easy On the constructive side I suggest that research problems can only be chosen by men who have a research instinct, by men who are following up a lead which may mean a real advance in our knowledge Such men are rare and therefore my first change would be in limiting the number of academic institutions in which research is done for advanced degrees This calls for a great unselfishness, while I am afraid that inevitably selfishness is characteristic of the attitude of the academic body to its students, perhaps unconscious, but arising out of the situation Thus if a senior has shown great promise it is natural for the graduate school to try to keep him when they should send him to another university where he will find the man best able to lead him on in the lines which he has chosen. Of course, if the graduate school of his own university can conscientiously hold him because they believe they can give him the best that there is in the country, then they are justified in doing so, but they should be extremely critical

In furthering this improvement I should like to

see the undergraduates acquire some critical faculty of their own, just as they do in Europe. This, I believe, can be brought about only by getting away from the idea that the university is merely a finishing up of an ordinary education and by adopting the European belief that it is a great advantage to move from one university to another, which can be done there without loss of effort In that way the student encounters different presentations of the same subject, and he learns to acquire a certain discrimination which seems totally lacking in the student's attitude to research in this country. When it comes time for him to do his doctor's work, he should be quite clear in mind that such and such a university, because of the research ability of the professor in charge of a single branch, is the only place in the country for him to go Since he can work his way about as easily in one place as another, there seems no reason why we should not be able to foster this procedure

I should like to see a definite stand taken against the point of view that because a conscientious young instructor has been promoted on account of his teaching ability to an assistant professorship, he is therefore entitled to experiment on graduate students Unless the young man has, by his own work, established the intrinsic merit of his attitude to research and his capacity for initiating research, he should not be allowed to act without the advice and direction of a maturer research man On the other hand, it should be recognized much more quickly than is often the case when the young man is a more brilliant research man than the head of the department, and then the head of the department should be honest enough to turn over his best students to the assistant professor

From my experience of industry and of academic research, I do not believe it possible for a man to function at the same time both as an executive of a large establishment, as a teacher and as a director of research. I do not believe it can be done, except by a great sacrifice of the highest attribute of the man, that most delicately balanced function of the mind which is the guiding spirit of research Therefore, I should like to reiterate what has been said so often, both by myself and others, that we should not reward research by executive responsibility and that we should relieve the true research man from the round of ordinary teaching and let him build up a research school fed by students from the countrywide, sent by his colleagues and the well-informed opinion of the student body.

I know that we argue for the complete independence of the research man and yet I should like to see a more collective effort made to unify the research effort of the country A young teacher, having carried out a small research problem which may have been a very secondary feature of a larger problem given him by his research master, starts in to do research for himself His mind is led, very naturally, to some little detail arising from the work he has done. That is good for him, but his view is too narrow and he is quite remarkable if he does not overestimate what is really quite trivial If we carried our national effort further and placed before our research men problems which might appear worth attacking because of their relation to still larger problems of importance in the opinion of the great research men in the field, I believe that these men would be tolerant enough to avoid the danger of stifling a new line thought out by a young man and yet we should have the advantage of far less wasted effort than we have at present, because I think we stretch much too far our sympathy with the piece of research which is just one more little pebble in the palace of knowledge We are too apt to encourage the collection of pebbles to put around the flower borders and grounds instead of hewn stone to build into new wings

Even assuming an excellent subject for a doctor's thesis it still may remain true that there is a waste. In industrial work the importance of time is stressed constantly, perhaps it is over-emphasized In academic work we have accepted the doctrine that accuracy is so much in danger of being sacrificed if an effort is made to speed up the work that we lean the other way I think we should remember that the real leaders of research, while they may have taken a great deal of time before they felt their results sure enough to present them to their colleagues, did actually work very fast in getting the evidence together. I remember that when his friends urged my old teacher Wislicenus to hurry up his publications for fear of losing his priority, he paid no attention whatsoever but went along gathering the data necessary At last he would publish and his paper would, perhaps, fill a whole volume of the *Annalen* His contribution was so finished, was so profound, that the matter of priority ceased to bother anybody, but from this it would be quite unfair to argue that he wasted time Actually he worked very rapidly and proceeded from step to step with a certainty that was most economical of effort.

Of course the young research man on his first problem is bound to waste a lot of time, but let us show him how to economize his effort and let us, above all things, point out to him that his loss of time is something which marks his immaturity rather than being the proper attitude toward the work he is doing. A young man may be able to observe only one reaction at a time, whereas a man with experience and a

higher critical faculty may undertake six parallel experiments with success, but let the young man do as much as possible and do not encourage him to think that it is the essence of research to watch the pot boil In this connection I think that it would be wisdom to devote a little more of the money available for research work to amplifying the apparatus available and to furnishing manual help so that dish washing might not be a necessary part of the research worker's time consumption I always remember the contrast that was presented in the attack on water analysis by the regular class in this subject at one of the universities at which I taught and by the government analyst on the same work The students carried out about two complete analyses in a semester, giving six hours a week of laboratory time to it The expert carried out, as I remember it, something between 10 and 15 analyses in parallel and was busy every instant of the time It would be impossible to expect such a high technique from students, but it is reasonable to demand the best they can give

In substance, then, my criticism of academic research is that it fails of being what it should, because the subjects chosen are not well selected, the time spent is out of all proportion to the results, and the effort is not sufficiently coordinate

My criticism I want to be taken as constructive, because I am, in reality, thoroughly in accord with the belief that academic research is fundamental to the success of the race It is on this account that I am glad to think that owing to the realization by those directly engaged in industry of the importance of the work done by their own research men, we shall see eventually a very great encouragement of basic research by men of wealth Already these men have found it possible to express their interest by giving magnificent laboratories, but they have not yet found a means of doing that which they realize is still more important, fostering the man of genius Obviously, it would only be the part of stupidity to feel that magnificent walls are a more permanent contribution and a fitter monument than a share in deeply significant work The rich man knows well that were he to succeed in raising the status of the scientist he would be wonderfully rewarded At present there is no very obvious way of doing this. Unquestionably our great research men should be able to look forward to earning salaries of $25,000 and over We must admit that our society is built up on success as measured in terms of money, and therefore a great man should have the satisfaction of independence, together with the stimulation of feeling that society has awarded him a position of success.

It is true that industrial scientists are not paid any such munificent salaries, yet they are placed in a position to participate in industrial success to an extent unknown in academic circles If a university were making 25 per cent clear on its investment and the merit of this financial success were traced in large part to special men on the teaching staff whose outstanding genius drew the large student body, it would be only fair to share the profit with them to some extent Actually this is practically what was done in Germany and it has resulted in the social status of the professor being all that he could ask and has made him relatively rich It also introduced the factor of competition among professors, which is most excellent though practically unknown in this country How can we make it possible that our great scientists should realize such success? I do not believe in tying up large endowments with particular chairs, because frequently the surroundings may be such that they prevent the best man available from being secured or the move essential to accepting the new chair may tear him from friendly surroundings which contribute largely to his success as a scientist Again I say I do believe in extremely handsome salaries as a reward of enlarging the domain of our basic knowledge and this irrespective of the apparent utility of the discoveries Surely we may count on enlightened response to this problem by the wealthy who have before them the admirable example set by Nobel, who, you will remember, stipulated that his prizes should not be awarded were there no worthy recipient found

INDUSTRIAL RESEARCH

Industrial research I define broadly as all research paid for by the owners of our industries, research being taken to mean anything out of the ordinary in the way of control work, as well as such utilization of basic knowledge as is necessary for greater economy in production I am willing to call research even that type of work which is no more than intelligent works control

Research is just as imperative to the existence of a large producing corporation as it is to the growth of science. That fact is generally recognized in this country. It is not so taken for granted, but it is no less true, that research is equally as important to the small concern. Unfortunately the small industrial unit does not feel that it can afford research. Actually the stockholders would find it a most profitable investment were they to plow back some of their profits into research However, there is every need for caution in this matter Usually it is true that the more isolated the research chemist the maturer he ought to be. I am a thorough believer in the genius of youth, but as an independent research

worker in surroundings which limit him strictly and force a great deal of routine upon him as well as a necessity for impressing owner-managers, the very young chemist can not compare with one of many years' experience It follows, then, that the smaller the company the more experienced should be their chemists, but good experienced men are necessarily more expensive than young ones, and the small company on deciding to choose a research chemist usually picks one unsuited to its needs They will pay a man $175 a month when they need the experience that makes a man worth $125 more than that The extra salary would make the whole outlay a very much better investment if they could but be brought to see it, an investment that would carry itself easily Another cause of trouble and unproductive expense is that a man hired to do research by directors or owners having but little knowledge of the real meaning of such work is put by them into a position calling for a great deal of routine, so much that real research is out of the question This discourages the chemist and disappoints his employers who consider research a failure because they have had only bills to pay and can see no return

In the case of large corporations conditions are very different They can afford research on a very generous scale Such research has to pay its way and to say this does not mean that directors are blind to the value of research even though there is no immediate return from it It means that the money of the stockholders must be spent profitably under the conditions existing at the moment It means that the research must have a direct purpose in view, it is not enough that it should extend our knowledge even though in that field of enterprise in which the industry grows

It is evident that herein lies the very most difficult problem of the research director In a large establishment he must delegate much of the detail to the senior men under him, but the choice of what is done must rest with him He must decide, in cooperation with his maturest men, whether a problem should be taken up fundamentally or empirically. Often a piece of work will be productive much sooner and will cost much less if it is treated from basic principles. For example, it may be that the establishment of the relation between certain fundamental physical constants and observed results when once correlated will enable the research man to formulate a general statement covering all cases in point and enable him to go ahead much more quickly than were he to try to find the most suitable material for his purpose by trial. On the other hand, it may be very much cheaper, though essentially less satisfactory, to learn by trial. It all depends on the problem in relation to the industrial requirement. This is the very striking difference between academic and industrial research It is one the young man, fresh from the university where he has been drilled in the importance of fundamentals, is very apt to ignore, with the consequence that he thinks ill of research done as he finds he is told to do it, he grows careless or he insists on going his own way and gets into trouble in either case

In a sense research that can not go to fundamentals and yet must bring results is more of an art than a science It is just on that account that it calls for a very high order of scientific training, otherwise it will degenerate into unproductive pottering, that worst curse of the research laboratory It takes patience and a good training to carry out work with the utmost elaboration, but it takes patience, training, experience and a certain type of sagacity if a man is to use his faculties as a guide and follow the scent without stopping to make sure of anything

I think that on the whole the work done by the industries, as far as subject-matter is concerned, is fairly satisfactory, more so, perhaps, than academic research Every now and then we run across some absurdity carried out by a research worker who has forgotten his elementary chemistry and physics and decides to prove or disprove some fact by experiment when he should be able to reason it out with pen, paper and a text-book I think also that on the whole industry utilizes its man power satisfactorily. I think that the rewards coming to the research worker in industry are on the whole adequate If I have any criticism it is that the industrial concern does not reward sufficiently the acquisition of experience that is invaluable, by that I mean that the knowledge acquired by a good man, after ten years as a specialist, can not be replaced unless the firm is lucky enough to have a subordinate growing up to fill the position Such a man should be made comfortable, should be kept satisfied, in order that he may do his best I am sure that the employers of research men are not sufficiently alert to the importance of preventing occupational stagnation if good research is to be done Every research man should have a chance to get away from his working surroundings and meet other scientific men at least once a year, quite without jeopardizing his vacation. He should be encouraged to develop as a man of culture as well as a specialist and on this account should he desire an extension of the two weeks' vacation in order to travel, such a request should be given sympathetic hearing Unless a research worker is growing in all directions mentally he is not fully efficient.

Turning to the time factor I think it fair to say on the whole that the industry is apt to force research

to be more hurried than is wise, but I am rather slow to make this statement because after a considerable experience I realize that there are a great many factors other than the mere acquisition of the information which must be taken into account Let us say that a research laboratory has developed a method on a small scale for making a product which promises to be very profitable The directors of the company believe that by an expenditure of a million dollars and provided they can begin production in six months they can obtain a handsome return on their investment Plans for the plant must be rushed, but plans depend, in the case of chemical plants, on the equipment to be housed and the equipment depends on the details of the process as carried out on a large scale Naturally the research necessary to put the process into shape for large scale production is rushed to an unhealthy extent and in consequence it is not unusual to find that a good deal of the equipment has to be scrapped later But this does not mean that the hurry was unwise It may be that in the long run the stockholders benefit more by the speed with which the work goes forward, even counting the loss of the equipment, than they would if time were taken to put the process into excellent shape One must remember that to do a thing perfectly from one point of view is not necessarily the best commercial procedure.

Of that work which is done in the research institutions of the country I am unable to say much because I have no direct experience. I believe that an institute like that founded by Rockefeller is one of the nation's greatest assets, largely because its contributions to medicine are international and tend to draw together the peoples of the world. As long as such institutes are in the hands of scientists of genius they will be of the utmost importance to us. They are expensive only when looked at from the narrow point of view of dollars and cents.

The professional men of this country are doing a great deal of good research They do this by observing carefully during their contacts with conditions as they find them They are taking the place, to some extent, of the rich amateur who at one time was the large contributor to scientific progress The difference is that the work of these men of to-day is more directly related to the practical use of science than was the work of men like Cavendish. Work of this kind carried out by physicians may flower into research work as richly endowed as that carried out at the Mayo Foundation, which has become a center of biological chemical research

In looking over the whole field of research in this country we should be satisfied that we are putting so much effort into so useful an endeavor We should not, however, be satisfied with things as they are and research, like everything else, must grow, must develop, if it is to mean all that it should to us. What we should strive to bear in mind is the truth of the statement made by John Milton

Our greatness will appear
Then most conspicuous, when
great things of small,
Useful of hurtful, prosperous of adverse,
We can create

R E ROSE

WILMINGTON, DELAWARE

A LITER AND A HALF OF BRAINS[1]

A LITER and a half is our portion. so much of it water that Hippocrates called the brain the metropolis of humidity and Sir Thomas Browne noted that, in consequence, skulls are less consumed by fire than other bones[2] Doubtless there are other functions of the brain for us to consider than that of rescuing the skull from a fiery oblivion

How greatly we extol ourselves above the brutes which perish Each of us, lords of creation, maintains within his skull as much brains as would fill the heads of three gorillas And very gravely we are told that for our bulk one third of all this mass would suffice, the rest is sheer intellect "which some suppose the soul's frail dwelling house"[3] But this is mere convention and with the times conventions change In Aristotle's day the brain was not, as some have said, the seat of sensation and of thought it is required rather to cool the blood and by thus tempering its heat to make sensation possible. Because man is the hottest of animals therefore he has the largest brain[4]

I talk of dreams,
Which are but children of an idle brain,
Begot of nothing but vain fantasy,
Which is as thin of substance as the air,
And more inconstant than the wind[5]

But enough Aristotle was born about 384 B C, when Plato was already forty-three and Socrates had been dead fifteen years The foundations of a study

[1] An address delivered at the annual banquet of the American College of Physicians, Cleveland, February 24, 1927.

[2] Sir Thomas Browne, "Hydriotaphia." D. Lloyd Roberts, ed London, 1898, p. 277.

[3] King John, V. 7. 3.

[4] Stocks, J L., "Aristotelianism." London and New York, 1927, p 76.

[5] "Romeo and Juliet," I, 4, 95

of the brain were laid by Herophilus, who was born in the closing part of the fourth century, B. C, and flourished at Alexandria during the reign of the first Ptolemy He discovered the nerves, distinguished them from sinews and thought the brain the center of the nervous system[6] This idea was elaborated by Galen in the second century, A D, who attacked Aristotle's theory of the heart as seat of the sensitive soul and the source of nervous action According to Galen sensation and movement are stopped and even the voice and breathing affected by injuries to the brain, moreover, injury to one side of the brain affects the opposite side of the body[7]

Augustine, in the early fifth century, speaks of three cells in the brain, of which the second is the seat of memory and the third of motor activity[8]

Costa ben Luca about 862 A D distinguishes between spirit and soul The spirit is a "subtle body," unlike the soul, which is incorporeal It passes from one cell to another and operates the vital processes of the body[9] The clearer and more subtle this spirit is, the more readily it lends itself to intellectual processes Hence intellectual processes are inferior in women and children and in races subjected to undue heat and cold like the Ethiopians and the Slavs We must not smile at this conception too broadly it is reproduced almost word for word in the great Paris discussions of last century regarding Negro brain and cranium[10] According to Costa ben Luca the opening between the first and second cells is closed by a sort of valve, "a particle of the brain similar to a worm" (the choroid plexus) When a man recalls something to memory the valve opens and the speed with which it opens explains why some men are slow of memory and others answer a question much sooner.

In the eleventh century Constantinus Africanus amplifies Augustine's conception of the three cells and puts imagination with sensation in the first, reason in the second and memory in the third[11] The first is hot and dry, the second cold and moist and the third cold and dry Mania is an infection of the anterior cell and melancholia a disease of the middle one.

In the twelfth century Petrocellus tells us definitely that good and evil are distinguished in the second cell and that the soul resides in the third[12]

In spite of Galen's teaching medieval scientists still clung to the conception of the brain being secondary to the heart Hildegard of Bingen, who died in 1180, A. D, speaks of the attenuation of humors in the chest whereby "the phlegm is dry and toxic and ascends to the brain There it produces headache and pain in the eyes and wasting of the marrow, and thus if the moon is defect he [the man] may develop the falling evil"[13]

Remember Jacques' joyful account of the fool he met in the forest, how

> "in his brain
> Which is as dry as the remainder biscuit
> After a voyage, he hath strange places cramm'd
> With observation, the which he vents
> In mangled forms."[14]

Adelard of Bath, "a dim and shadowy figure in the history of European learning," who according to the Pipe Roll of 1130 received four shillings and six pence from the sheriff of Wiltshire, states that it was discovered experimentally which portion of the brain is devoted to the imagination and which to reason and memory through a case in which a man was injured in the front part of the head[15] The famous specimen in the Warren Museum is therefore antedated by some seven hundred years

In the following century, about 1230, A D, Bartholemew the Englishman cites Constantinus' division of mania from melancholia as diseases of first and second cells, respectively, and tells of a nobleman whom he knew, suffering from melancholia and imagining himself to be a cat, who insisted on sleeping under the bed to watch the mouse holes[16]

And a little later, about 1292, Arnold of Villanova in the Breviary of Practice, discussing the treatment of mania, advises as a last resort that the skin be cut in the form of a cross and the skull perforated so that the noxious vapors may escape from the brain[17] "I'll ne'er believe a madman," says the clown in Twelfth Night, "till I see his brains."[18]

In the Bodleian Library at Oxford is a small quarto parchment in a fine Italian hand, the first complete treatise on anatomy in the vernacular, written in

[6] Thorndike, L, 1923, "A History of Magic and Experimental Science," Vol I, p 145

[7] *Ibid.*, p. 146.

[8] *Ibid.*, p. 660

[9] *Ibid*, pp. 658–9

[10] Gratiolet, P, for example, 1856, "Mémoire sur le développement de la forme du crâne de l'homme," etc Compt. rend. de l'acad. des Sc. T 43, pp 428–431.

[11] Thorndike, L., Vol. I, p 660

[12] Thorndike, L, Vol I, p 735

[13] Singer, C, 1917, "The Scientific Views and Visions of Saint Hildegard Studies in the History and Method of Science." Vol. 1, Oxford, p. 47.

[14] "As You Like It," II, 7, 38.

[15] Thorndike, L, Vol. ii, p 39

[16] *Ibid.*, p 408.

[17] *Ibid.*, p. 860

[18] "Twelfth Night," IV, 2, 126.

1490. It is the Anothomia of Hieronymo Manfred[19] Here is a pretty accurate description of the cerebral ventricles not greatly bettered until Leonardo made his ventricular casts.[20]

> "To the side of this [the foramina of Monro] is an other thing like a subterranean worm, red as blood, yet tethered by certain ligaments and nervelets And this worm when it lengthens itself closes these passages, and thus blocks the path between the first ventricle and the second Nature has wrought it thus, so that when a man wills he may cease from cogitation and thought, and similarly when, on the other hand, he would think and contemplate, this worm contracts itself again and opens these passages"
>
> "It will be apparent that when the back part of the head is injured, the memory immediately suffers, when the middle part is injured, the estimative and cognitive faculties suffer, and when the anterior part is injured, the faculties of common sensation and imagination suffer And thus it is that the doctors have become aware of the location of these powers."

But why continue Descartes and others, by gradual degrees have laid the sure foundation of modern study of the brain and we may pass lightly by this phase to explore more recent fancies in which Reserve has had her part. The philosophic conception of three primary vesicles was written into scientific anatomy by Leonardo and remains there in current descriptions So hard does tradition die

In recent years there have been numerous efforts to prove or disprove the hypothesis that head size is related to brain volume, in the present state of our knowledge a perilous task unless the brains are out and the man is dead[21] People do not really like having their heads measured and if they suspect that the measurement is undertaken with a view to estimating brain volume something very like active rebellion ensues. When Professor Karl Pearson's assistants endeavored to make this determination upon Cambridge undergraduatees, the students, by playing tricks on the observers, almost brought the work to nought[22] It reminds one of Falstaff's exclamation, "Well, if I be served such another trick, I'll have my brains ta'en out and buttered, and give them to a dog for a new year's gift"[23]

There is a common tendency to compare, or rather contrast, the average brain volumes in different classes of society This must be done only with the greatest care, it is doubtful if it is ever a valid method, for differences of environment and nurture have a profound influence upon head size For the comparison to be apt one must take a fairly homogeneous sample of approximately the same nurture and habits[22]

Of one thing I am very certain, namely, that *class distinction in our highly artificial and fluctuating* society to-day is not the crowbar wherewith to pry open this problem of brains And so we have tried another tool put into our hand by luck Ever since 1913 we have kept a steady watch upon head size and brain volume of those unfortunates who, having ended their days already, terminate their corporeal existence under our care Reserve occupies a unique position in this matter, having long enjoyed to an extraordinary degree the spirit of cooperation with the city Dr Hamann's statesmanship and Mr Leonhart's tact have resulted in our acting as a kind of permanent morgue in which is represented a fair cross section of Cleveland's outmaneuvered victims in the struggle for existence.

The average brain volume for the adult white man is generally accepted as about 1,500 cc, perhaps a few cc more, probably no less Among the diners here to-night, who may be classed as highly intellectual, the mean value is probably 1,550 cc The average among Cleveland's social ineffectives from 1913 to 1917 was quite constantly within 10 cc of 1,480 cc This difference made no impression upon us until in 1918 a strange thing happened Our average fell to 1,410 cc. Now during that year none but the veriest fool was left destitute the others were all in the army or earning good wages in civilian life Still we were not stirred to attention. But in 1919 when, after the armistice, industrial stagnation set in and threw out of work many who had recently found jobs, and when, moreover, the disbanding army disgorged a glut of men upon a society which could not immediately absorb them, the average brain volume of our social failures rose to 1,520 cc. That looked serious to us and with great interest we read the prognosis of bankers and captains of industry regarding the future According to prediction the situation improved in 1920 and our mean brain volume sank once more to near the pre-war level. But the feeling of satisfaction soon gave place to apprehension, for a second and much worse industrial

[19] Singer, C, 1917, "The Anothomia of Hieronymo Manfredi (1490)"—"Studies in the History and Method of Science," Vol I, Oxford

[20] Hopstock, H, 1921, "Leonardo as anatomist"—"Studies in the History and Method of Science," Vol ii, Oxford

[21] "Macbeth," III, 4, 79.

[22] Pearson, K, 1902, "On the Correlation of Intellectual Ability with the Size and Shape of the Head," Proc. Roy Soc, Lond Vol 69, pp 333–342, also 1906, "On the Relationship of Intelligence to Size and Shape of Head," *Biometrika*, Vol. 5, pp 105 to 146

[23] "The Merry Wives of Windsor," III, 5, 7.

depression set in, distress growing steadily more acute during the months of 1921. Then indeed we watched our steadily mounting average volume Day by day, like obscene demons from the pit itself, we chalked up the rising score until it reached the appalling level of 1,550 cc. Here was a new class of men entering our portals and they came by a different route Here were the men who could think for themselves, who knew and resented their fate The pneumonia of the shiftless, the tuberculosis of the over-wearied struggler, the heart disease of the adventurer no longer acted alone as our receiving agents Instead men shot themselves, or each other, threw themselves into the lake, poisoned themselves with morphine or raisin jack, perished of cold, listlessly lost in despair All through that year and into the early months of 1922 the steady shuffle of feet on the doorstep of the Associated Charities swelled its monotonous dirge Agitation was rife Russia and Germany were pointed out as members of the community of nations who had passed that way before And then, suddenly as it had begun, while yet the Charities were deluged with the throng, these expectant ghouls in anatomy saw the barometer of brain volume begin to fall, steadily, steadily down. Relief had come though it was not apparent to the city we knew the end was in sight Hope was restored again in those whose nervous system had been shattered by defeat Never again have we seen the like Slight fluctuations from year to year and an average somewhat above the pre-war mean have been our lot but never that alarming rise which we experienced in the year of intense depression.

Now these things sent us back to examine our data anew and we soon found that of two heads of the same size one might have as much as 200 cc of brain more than the other It was not that we got larger heads in 1919 and 1921, but we got bigger brains among our social ineffectives. In normal times our pauper population is recruited from that flotsam and jetsam of humanity which idly drifts along the shores of these great lakes. "Here's Agamemnon, an honest fellow enough, and one that loves quails, but he has not so much brain as ear wax."[24] When, however, industrial distress overclouds the city new recruits appear, the honest industrious poor with too little margin for the rainy day, "purse and brain both empty, the brain the heavier for being too light . . O, the charity of a penny cord! It sums up thousands in a trice . . your neck, sir, is pen, book and counters, so the acquittance follows."[25] Then there rush in, as if impatiently, the men who in indifferent times can do indifferent well, but owing to some frailty of their intellect are crushed down by a sudden galloping destitution "Your hearts I'll stamp out with my horse's heels, and make a quagmire of your mingled brain"[26]

That, ladies and gentlemen, is the romance of the liter and a half It is not the quantity but the quality that matters It is not the quality of the whole but of the last small wine glassful Taking mean values, 1,480 cc are needed for a fool, 1,500 cc for an honest man And on the average a lady's cocktail saves us from inanity.

T WINGATE TODD

HAMANN MUSEUM,
WESTERN RESERVE UNIVERSITY

SCIENTIFIC EVENTS

BRITISH ROYAL COMMISSION ON MUSEUMS AND GALLERIES

THE London *Gazette* announces the appointment of a Royal Commission on Museums and Galleries, with wide terms of reference The members of the commission are Lord D'Abernon (chairman), Mr Evan Charteris, K C, Sir Thomas Little Heath, Sir Lionel Earle, Sir Richard Tetley Glazebrook, Sir George Macdonald, Sir Courtauld Thomson, Sir Martin Conway, Sir Henry Miers, Sir Robert Witt and Dr. A E Cowley

The terms of reference are as follows

(1) To inquire into and report on the legal position, organization, administration, accommodation, the structural condition of the buildings, and general cost of the institutions containing the national collections situate in London and Edinburgh—namely, the British Museum and the Natural History Museum, the National Gallery and the National Gallery of British Art (Tate Gallery), the National Portrait Gallery, the Public Record Office, the Victoria and Albert Museum, the Bethnal Green Museum, the Science Museum, the Geological Museum, the Wallace Collection, the Royal Botanic Gardens, Kew, the London Museum, the Imperial War Museum, the Royal Scottish Museum, the National Galleries, Scotland, the Scottish Museum of Antiquities and the National Library, Scotland, the Record Department of the Registry House, Edinburgh

(2) To investigate the existing conditions of the various collections and their growth in former years and to report in the case of each institution what is likely to be the growth of its collections and what the consequential increase in expenditure in the next fifty years if the present practice regulating acquisitions remain unaltered

(3) To consider in what way, if any, expenditure may be limited without crippling the educational and general usefulness of the institutions, and in particular, having regard to the financial condition of the country, whether

[24] "Troilus and Cressida," V, 1, 58.

[25] "Cymbeline," V, 4, 166.

[26] "I King Henry VI," I, 4, 109.

it would be desirable to institute a more general system of admission fees

(4) To inquire to what extent there is congestion in museums and galleries and to report whether, if there be such congestion, it can be relieved in any other way than by extensive building and in particular whether improvement could be brought about by a redistribution of specimens between different state supported institutions or by disposal of specimens which may be either of slight importance or in excess of requirements, by way of sale or of gift or loan to provincial museums and galleries and to other authorities, and in this connection to ascertain the practice followed in the case of the chief national collections abroad.

(5) To consider whether it is desirable to effect any change in the existing practice of the British Museum with regard to its reception and preservation of publications under the provisions of the Copyright Acts

(6) To consider whether the existing administrative responsibility for the various institutions is the most appropriate under modern conditions and whether it conduces to the most advantageous distribution and display of the national treasures, and to report whether it would be desirable, while preserving certain defined powers to their trustees or directors, to place them all under some central authority or under different authorities than those at present controlling them

(7) To report whether the most suitable and scientific arrangement of specimens and their allocation to the most appropriate museum or gallery are in any way hampered by the terms of benefactors' bequests, and, if so, whether it would be expedient to take steps with a view to a modification of the terms of such bequests

(8) To make recommendations generally which may suggest themselves as pertinent in the light of the information obtained during the course of the inquiry

EXCURSION OF THE ELECTROCHEMISTS

THE American Electrochemical Society will board a special train at Chicago on September 4, traveling as far as Seattle and Vancouver and returning to Chicago on September 21 All the important electrolytic plants, research and university laboratories and power developments *en route* will be visited Stops will be made at the following towns Minneapolis, Butte, Anaconda, Wallace, Kellogg, Spokane, Seattle, Vancouver, Trail, Shelby, Great Falls and Keokuk

America is leading the world in the production of electrolytic zinc, electrolytic lead and electrolytic copper, and ample opportunities will be offered to see the very latest production of the pure metals, starting from the mineral

Power development in the Northwest has been progressing on a very elaborate scale, and the electrochemists are interested in new centers for the establishment of various electrolytic industries

There will be three scientific sessions held *en route*, one at Minneapolis, another at Vancouver and a third at Keokuk The papers' program includes a wide diversity of subjects, ranging from the electrodeposition of rubber to thin film rectifiers.

A large number of members and guests have made reservations for the trip The total cost, including berth and meals, starting from and returning to Chicago, is estimated at $182 Further details are obtainable at the offices of the American Electrochemical Society, Columbia University, New York City

THE HERMAN FRASCH FOUNDATION FOR CHEMICAL RESEARCH

BY a decision of the Court of Appeals, a bequest of the residuary estate of Mrs Elizabeth Blee Frasch, widow of Herman Frasch, for many years president of the Union Sulphur Company, which directed that the income of the gift of $1,000,000 was to be used for chemical research in the field of agricultural chemistry, is upheld

The will of Mrs Frasch left her residuary estate, received largely from her husband, who was a well-known chemist, to the United States Trust Company to establish the Herman Frasch Foundation for Chemical Research She directed that the income be paid to one or more incorporated institutions in the United States, to be selected by the trust company, after consulting with the American Chemical Society, "upon condition that the said institution shall agree that the money so received shall be devoted to research in the field of agricultural chemistry with the object of attaining results which shall be of practical benefit to the agricultural development of the United States"

Mrs Frasch directed that the institution so selected should have the use of the funds for five years after her death, and that before the end of this period the trustee should request the American Chemical Society to examine the work done by the institutions and report "whether in its opinion satisfactory progress has been made with the funds of the foundation toward the attainment of such practical results." If the society reported that satisfactory progress had not been made, payments would cease, and another institution would be selected to make use of the income for five years, after which another inquiry would be made

The bequest was contested on the ground that by the terms of the will the income might be used for private research which would deprive the gift of its charitable purpose Judge Lehman in his opinion said that although Mrs Frasch undoubtedly intended to create a trust "for purposes which would advance the public welfare," such intention "is not sufficient to give validity to a perpetual trust for the benefit of indefinite and uncertain persons" unless authorized by a law of 1893, now a section of the Personal Property Law of New York, based on the Statute of Elizabeth, which applies to a gift for religious, educational,

charitable or benevolent uses The court pointed out that the statute does not provide for the legality of bequests given for research work, but said

Research is the method used by modern universities and scientific foundations to increase the sum of human knowledge Research conducted for such purpose and by such institutions is clearly "educational" and "benevolent" within the meaning of the statute Not every charitable, educational or benevolent use is enumerated in the Statute of Elizabeth, although that statute was intended to limit the trusts for charitable uses, which might be enforced by a court of equity Conceptions of public charity, benevolence and education change with passing generations

ORGANIZATION OF THE ROCKEFELLER FOUNDATION

The following are the members and officers of the Rockefeller Foundation for 1927 under a new plan of organization

Members John G Agar, John W Davis, David L Edsall, Simon Flexner, Raymond B Fosdick, Herbert S Hadley, Charles E Hughes, Vernon Kellogg, John D Rockefeller, Jr, Wickliffe Rose, Julius Rosenwald, Martin A Ryerson, Frederick Strauss, George E Vincent, George H Whipple, William Allen White, Ray Lyman Wilbur

Officers John D Rockefeller, Jr, Chairman of Board of Trustees, George E Vincent, President, Edwin R Embree, Vice President in New York office, Roger S Greene, Vice President in the Far East, Selskar M Gunn, Vice President in Europe, Frederick F Russell, M D, Director International Health Division, Richard M Pearce, M D, Director Division of Medical Education, Norma S Thompson, Secretary, Louis G Myers, Treasurer, George J Beal, Comptroller

Executive Committee The President, Chairman, John G Agar, Simon Flexner, Raymond B Fosdick, Vernon Kellogg, Wickliffe Rose, Frederick Strauss, Norma S Thompson, Secretary

International Health Division The President, Chairman, Simon Flexner, Vernon Kellogg, Wickliffe Rose, William Allen White

Division of Medical Education The President, Chairman; David L Edsall, Frederick Strauss, George H Whipple, Ray Lyman Wilbur

Finance Committee. John D Rockefeller, Jr, Chairman, Raymond B. Fosdick, Frederick Strauss

The Foundation holds regular meetings in February and November The executive committee holds monthly meetings.

SCIENTIFIC NOTES AND NEWS

The Osiris Prize for science amounting to $4,000, which is bestowed every five years by a committee representing five academies, has been awarded to Dr. Charles Nicolle, director of the Pasteur Institute in Tunis, for his researches on exanthematous typhus and recurrent fever and their mode of transmission by parasites; also for his researches on serotherapy in measles and scarlet fever, especially the injection of convalescents' serum

The Royal Society of Edinburgh has elected as honorary British fellows Sir William Bragg, Sir David Bruce, Sir J B Farmer and Sir F G. Hopkins Foreign honorary fellows have been elected as follows Niels Bohr, professor of physics, University of Copenhagen, Jules Bordet, professor of bacteriology, University of Brussels, Albert Einstein, professor of mathematical physics, University of Berlin, Hans Horst Meyer, emeritus professor of pharmacology, University of Vienna, Johannes Schmidt, Carlsberg Laboratory, Copenhagen, and Richard Willstatter, professor of chemistry, University of Munich

The commission for a portrait of Sir Berkeley Moynihan, president of the Royal College of Surgeons, has been placed by the Moynihan Portrait Fund Committee with Mr Richard Jack, R A, who has also been given a commission for a replica

Professor Edward Skinner King, of the Harvard College Observatory, was granted the honorary degree of doctor of science by Hamilton College, at its recent commencement exercises

Dr. Guy L Noyes, dean of the school of medicine and director of the University Hospitals, of the University of Missouri, was the guest of honor at a luncheon in Boston recently, given by the University of Missouri men who are finishing their course in medicine in Harvard University

Dr. Cassius J Keyser, who has been connected with the mathematical department of Columbia University since 1896, when he was awarded the degree of A M, since 1904 Adrain professor of mathematics, has become professor emeritus

Professor J A MacWilliam has retired from the chair of physiology in the University of Aberdeen which he has filled for a period of forty-one years.

At a recent meeting of the British Institution of Electrical Engineers, Mr. A. Page was elected president and Captain J M Donaldson, vice-president, to take office on September 30.

Dr. K Nakamura, president of the Tokyo Higher Technical School and for a number of years head of its department of electrical engineering, was recently elected president of the Japanese Institute of Electrical Engineers.

Dr. Masujiro Nishibe, of the laboratory for infec-

tious diseases of the Japan government, and Dr Shoji Nishio, of the Keio University Medical School, Japan, have received fellowships under the Rockefeller Foundation for the year 1927, and will pursue their studies in the United States

W W SARGEANT, who has been secretary of the board of trustees of the California Academy of Sciences since 1913, has resigned in order that he may spend some years in Europe Miss Susie M. Peers, who has been secretary to the director of the museum of the academy since 1915, has been appointed secretary to the board

DR. ROGER C WELLS, of the U S Geological Survey, has accepted appointment as associate editor of the Washington Academy of Sciences to represent the Chemical Society

G BERNARD HELMRICH, who has been connected with the engineering faculty of the University of Oklahoma for the last ten years, has rejoined the Detroit Edison Company in the capacity of designing engineer

E C LARUE, head of the Pasadena branch of the U S Geological Survey, has resigned after twenty-three years of service According to the technical journals, the reason assigned was that the government had prohibited him from advocating his opinions and beliefs with reference to the Colorado River Mr. LaRue is a recognized authority on the Colorado River and its water problems and was called to Washington before the congressional committee investigating the Colorado River following attacks on the Boulder Canyon project, which he styled as extravagant and not as practical as others which he outlined

DR EDWARD R WEIDLEIN, director of the Mellon Institute of Industrial Research of the University of Pittsburgh and president of the American Institute of Chemical Engineers, will spend September and October in visits to European educational institutions, research laboratories and chemical works

DR WILLIAM H EYSTER, professor of botany at Bucknell University, Lewisburg, Pa, is sailing on August 20 for Germany, where he will spend twelve months as a fellow on the John Simon Guggenheim Memorial Foundation His address will be Pflanzenphysiologisches Institut der Universität, Berlin-Dahlem, Germany

DR. DAVID FAIRCHILD, senior agricultural explorer of the U S Department of Agriculture, and his associates, after a voyage to the Canaries and West Africa, including Senegal, Gambia, French Guinea, Gold Coast, Sierra Leone, Nigeria and Fernando Po, has returned to the United States on the motor yacht *Otowana*, owned by Mr Allison V Armour

ELLSWORTH P. KILLIP, of the National Museum, has returned from a botanical trip to the Eastern Cordillera of Colombia. The party, consisting of Mr Killip and Albert C Smith, of New York, was sent by the National Museum, the New York Botanical Garden, the Gray Herbarium of Harvard University, and the Arnold Arboretum to obtain botanical specimens in the little-known region between Bucaramanga and the Venezuelan border

DR. N. H DARTON, of the U S Geological Survey, has returned from Central Venezuela where he has been making geologic reconnaissance surveys for an oil company during the past six months

DR FREDERICK STARR, associate professor emeritus of anthropology at the University of Chicago, who has returned from Japan, gave on August 2 a lecture at the university on life in that archipelago

DR. AIHIKO SATA, formerly president of the Osaka Medical College in Japan, left in May for a lecture tour through Germany as exchange professor at the University of Berlin; his lectures will be on immunization of tuberculosis

A COMMEMORATION in celebration of Lord Lister's centenary was held in Edinburgh on July 20, at the time of the meeting of the British Medical Association The Earl of Balfour presided and addresses were delivered by Sir William Watson Cheyne, Professor Tuffier, Paris; Professor Harvey Cushing, Harvard University, and Professor John Stewart, Halifax, Nova Scotia.

CAESAR AUGUSTINE GRASSELLI, chairman of the board of the Grasselli Chemical Company, died on July 28, aged seventy-seven years

RALPH LUSK, instructor in the department of geology at Harvard University, has died suddenly at the age of thirty years

J. H PAARMANN, curator of the Davenport Academy of Sciences (now the Davenport Public Museum) since 1902, died on July 14 He was born September 2, 1870, and received his academic degrees from the State University of Iowa.

SIR HARRY JOHNSTON, the well-known explorer, naturalist and author, died in London on July 31, aged sixty-nine years.

PROFESSOR A. KOSSEL, emeritus professor of physiology in the University of Heidelberg and editor of the *Zeitschrift für physiologische Chemie*, who was Nobel laureate for physiology in 1910, died on July 6, aged seventy-three years.

DR. GUSTAV FRITSCH, professor of anatomy and physiology in the University of Berlin, has died at the age of eighty-nine years

Dr. Karl Baldus, assistant of the zoological institute of the University of Heidelberg, died on June 26 Dr Baldus published important contributions concerning the histology and physiology of the brain and the function of the eyes in dragon-flies

Popular Astronomy reports that Professor Vincenzo Cerulli, the Italian astronomer, vice-president of the International Astronomical Union and of the Astronomische Gesellschaft, president of the Societa Astronomica Italiana, honorary professor of astronomy at the University of Rome, died suddenly on May 30, at Merate (near Milan), during the inaugural ceremony of the new observatory Professor Cerulli was born at Teramo (Abruzzi) on April 20, 1859

Civil service examinations are announced as follows For vacancies in the Bureau of Chemistry and Soils, at a salary of $3,000 a year, applications to be received not later than August 9, for associate biochemist in the Bureau of Plant Industry, at a salary of $3,000 to $3,600, applications to be received by August 16, and for physicist in the Berkeley, Calif, office of the Bureau of Chemistry, at a salary of $3,800, applications to be received by August 31

By the will of the late Charles Fuller Baker, dean of the College of Agriculture of the University of the Philippines, his zoological collection, comprising more than 50,000 specimens, has been given to the Smithsonian Institution, and collections of less extent to the universities of Berlin, London, Madrid, Paris, Moscow and Vienna

The meeting of the International Congress of Physicists will take place at Como, the birthplace of Allessandro Volta A special celebration in connection with the meeting has been arranged for September 8.

The American Mathematical Society, the Mathematical Association of America and the American Astronomical Society will hold their meetings at the University of Wisconsin during the week of September 5 to 10.

The Second National Symposium on General Organic Chemistry will be held at Ohio State University, Columbus, on December 29 and 31. The headquarters will be at the Neil House. Suggestions for the program should be sent to the secretary of the division of organic chemistry of the American Chemical Society, Professor Frank C Whitmore, Northwestern University, Evanston, Illinois

The annual Pacific Coast convention of the American Institute of Electrical Engineers will be held at Del Monte, Calif., from September 13 to 16 This is one of the three annual national conventions of the institute The first day (Tuesday) will be given over to the registration and sessions of delegates from the various student branches The student conference will be in charge of R W Sorensen, professor of electrical engineering at the California Institute of Technology, Pasadena On Wednesday, Thursday and Friday mornings and Thursday afternoon there will be technical sessions. On Wednesday evening President Gherardi will preside over a general meeting to be addressed by Dr Harris J Ryan on "Phases of Future Electrical Development" The banquet will be held Thursday evening Wednesday and Friday afternoons and Saturday will be open for recreation and trips

An Institute of Cooperation, in which speakers of national prominence in the field of agricultural cooperation will participate, is to be held at Storrs, Conn, from August 16 to 19, under the auspices of the Connecticut Agricultural College Dr E G Nourse, formerly professor of agricultural economics at Iowa State College and now chief of the agricultural division of the Institute of Economics, Washington, D. C, and Dr J T. Horner, of the Michigan Agricultural College, an authority on milk marketing, are scheduled to address the institute J W Jones, division of cooperative marketing, Bureau of Agricultural Economics of this department, will discuss tobacco marketing Professor A E Cance, of Massachusetts Agricultural College, Dr R B Corbett, of Rhode Island State College, and F. V Waugh, of the Massachusetts Bureau of Markets, are also on the program Though arranged primarily for directors, officers and managers of cooperatives, the institute is open to all who are interested in the cooperative marketing of farm products or the buying of farm supplies.

The British Medical Journal states that on the occasion of the centenary of the Faculty of Medicine of the Egyptian University, Cairo, the Egyptian government has decided to organize a medical congress in Cairo, to deal especially with tropical medicine and hygiene The congress will take place in the winter of 1928, probably in November or December The constitution of the organization committee will shortly be announced officially It is understood that invitations will be sent to universities and institutions particularly interested in tropical medicine and hygiene and their branches

A bill has been passed by the Egyptian Parliament, according to which there will be created a Ministry of Public Health of the national government. Previously the supervision of public health work was under the Ministry of the Interior The rapid growth of government health work, particularly in the country dis-

tricts, has made necessary the creation of the new executive department A minister has not as yet been named for the new position In creating the new ministry, parliament appropriated about $5,000,000 to cover its budget during the fiscal year 1927–1928

CONSTRUCTION of a special hospital for the School of Tropical Medicine at Porto Rico was begun on June 1 The hospital will occupy a site adjoining that of the laboratory building of the school, and will contain forty-five beds and an out-patient department The cost of the building and equipment will be approximately $130,000

THE Legislature of Hawaii has again appropriated the sum of fifteen thousand dollars for the work of the Pan-Pacific Union, this being the amount recommended by the Governor of the Territory and the usual appropriation made by the Hawaiian Legislature Besides this about twenty thousand dollars a year is given annually by friends of the Pan-Pacific Union in Hawaii for its support, besides occasional appropriations from governments of Pacific countries Each country supports its own Pan-Pacific organizations and sends delegates to the conferences called by the Pan-Pacific Union In June, 1928, there will be a Pan-Pacific Women's Conference held in Honolulu In July, 1928, a second Pan-Pacific Commercial Conference in Los Angeles In July, 1928, a Pan-Pacific Medical Conference in Honolulu, with several smaller conferences of scientists as guests of the Pan-Pacific Research Institution

THE *Journal* of the American Medical Association reports that about 135 scientific men and physicians attended the recent dedication, sponsored by the Zoological Society of San Diego, of the Zoological Hospital and Research Institute, San Diego, which is a gift of Miss Ellen C Scripps Physicians interested in research are invited to avail themselves of its facilities, no charge being made except for material used or broken The building is located in a large zoological garden It will be a hospital for animals in the garden, and pathologic tissues from zoological gardens throughout the country will be collected for a study of animal diseases Physicians, research workers and students in biology will find here the necessary equipment for carrying on research There are eleven small laboratories, each equipped for special work, a roentgen-ray and darkroom, a library, general laboratory, technician's laboratory offices and morgue and a photomicrographic outfit The plan is to afford college professors and advanced students an opportunity to continue studies when in California, and to attract biologists interested in avian and mammalian research, as do some noted marine biologic stations Further information will be given on request to the hospital, Balboa Park, San Diego Dr Rawson J Pickard is chairman of the hospital and research committee, and H C Goodall, director of research and education

FOR years "The Friends of our Native Landscape" have worked for the reservation of the Sayer Bog—a typical tamarack bog—and the only one of its kind in Illinois A number of bogs have been drained and destroyed, but there are still seven or eight left with an incomplete flora For students and scientists of this region the Sayer Bog will be of great value, and as a bit of native landscape it is one of the outstanding monuments of its kind of this region Under the agreement with the present owners—the Pistakee Country Club—the bog is placed under the supervision of the Northwestern University with Dr. Waterman in charge The agreement further stipulates that the Pistakee Country Club will guard against trespassers and protect the bog from being drained by adjoining neighbors The owners agree that in case they should desire to dispose of this property Northwestern University will be given the first chance to buy the bog at the original purchase price Visitors must obtain permission to visit the bog through the Northwestern University

ACCORDING to information received from Professor Subbotin, of the Tashkent Observatory, a new station for the continuous observation of latitude variations is to be established at Kitab, in Turkestan, on the "International Parallel" (39° 8′ North) In 1899, six stations were established on this parallel by international cooperation Owing to the war and other causes, three of them have been discontinued, leaving only three in operation at the present time The new station at Kitab is about three hundred km. east of the former latitude station at Tchardjui, and about 300 km southwest of the observatory at Tashkent It will be under the charge of Professor Nefediev.

IN continuation of a program of scientific research in mining and metallurgy conducted jointly by the Carnegie Institute of Technology and the Pittsburgh Station of the U. S Bureau of Mines, eleven college graduates have been appointed to research fellowships for the coming year Six of the appointees will conduct their investigations in the field of metallurgy and five will study problems in mining and utilization of fuels Appointments to mining fellowships were as follows. Harry A Brown, B.S, chemical engineering, Lehigh University, Raymond C. Johnson, B.S., chemistry, Monmouth College, Harold M. Morris, A B, chemistry, Cornell College, Robert N Pollock, B S., chemistry, and Donald L. Reed, B S, chemical engineering, University of Washington Appointments to metallurgical fellowships were: John M. Byrns, B.S.,

metallurgical engineering, Case School of Applied Science, John F. Eckel, A.B., chemistry, University of Kansas; Hyman Freeman, B.S., engineering chemistry, Georgia School of Technology, Frank C. Norris, B.S., chemical engineering, University of Illinois, and Harold E. White, E.M., mining and metallurgy, Lehigh University. The research fellows will begin their work on August 15 for a period of ten months. Two advisory boards, one composed of mining engineers and operators, and the other of metallurgical engineers and steel executives, will assist in selecting the problems for study. Each research fellow will conduct his studies under the direction of a senior investigator from the Bureau of Mines. At the completion of their studies they will be eligible to receive the degree of master of science from the Carnegie Institute of Technology. As in the past, reports of the investigations to be made during the coming college year will be published in bulletin form for public distribution.

UNIVERSITY AND EDUCATIONAL NOTES

By the will of Randolph McNutt, a furniture dealer of Buffalo, N. Y., Dartmouth College receives the residuary estate, valued at more than $750,000, to be used for general educational purposes.

An annual appropriation of $10,000 for five years has been given to Princeton University by the Public Service Electric and Gas Company of New Jersey for the advance of "pure scientific research."

The Burma Oil Company has offered £100,000 to the new Rangoon University, India, for a college of mining and engineering, to be associated with the name of the company.

Dr. Barnett Sure, of the College of Agriculture of the University of Arkansas, has been promoted to a professorship and has been appointed head of the department of agricultural chemistry.

Dr. James B. Kendrick, of the department of botany of Purdue University Agricultural Experiment Station, has been appointed associate professor in the division of plant pathology of the University of California, at the experiment station at Davis, California.

Dr. G. L. Clark, assistant professor of chemistry in the chemical engineering department of the Massachusetts Institute of Technology, will succeed Dr. G. D. Beal next year at the University of Illinois, where he has been appointed associate professor.

S. F. Bibb, of the University of North Dakota, has been appointed professor of mathematics at the Armour Institute of Technology.

Dr. I. de Burgh Daly, lecturer in experimental physiology in the Welsh National School of Medicine of the University of Wales, Cardiff, has been appointed to the chair of physiology in the University of Birmingham to succeed Professor E. Wace Carlier, who has retired.

DISCUSSION AND CORRESPONDENCE

THE STACKABILITY OF TETRAKAIDECAHEDRA

In the issue of Science for June 18, 1926, Frederic T. Lewis, in a communication entitled "An Objective Demonstration of the Shape of Cells in Masses," makes the following statement: "Meanwhile Lord Kelvin had found that a fourteen-sided figure—a cube truncated by an octahedron[1]—having six quadrilateral and eight hexagonal surfaces, solves the problem of dividing space without interstices into uniform bodies of minimal surface."

In the issue of Science for September 3, 1926, John Millis, in a communication under the title, "The Shape of Cells in Masses," begins his paper with the above quotation from the article by Lewis. Millis continues as follows: "The statement is a correct expression of Lord Kelvin's claim as set forth in the somewhat famous Baltimore lectures of several years ago. But the claim is entirely wrong. Having been myself perplexed by so direct and confident an announcement from such an eminent source, let me ask that a definite correction of a serious error be now made in order that others may be saved from being misled and perhaps from consequent mistakes. The volume described, called the tetrakaidecahedron, does not possess the properties as stated. Equal volumes of this pattern will not fit together without voids, as a brief consideration of the dihedral angles or the angles between the faces and the relations of the faces or a practical trial with models would at once have shown."

Such a positive and detailed criticism, pointing out the claimed "error" in Lord Kelvin's equally positive statement, supported by Lewis, might have settled the matter, except that the writer took the suggestion made by Millis in the last sentence quoted above and considered the dihedral angles and even constructed models as advised. If one consider the cross-sectional plane through the center of the volume (passing the sectioning plane perpendicularly through a face of the figure), the resulting section is a hexagon. If we consider the angles in the hexagon we find that they are equal to the corresponding dihedral angles of the volume in question and are as follows.

[1] "The edges of a regular octahe[illegible] are trisected. Each vertex of the octahedron is the[illegible]off by a plane passing through the points of tris[illegible]djacent to the vertex. The resulting solid is [illegible]r tetrakaidecahedron."—Graustein

(1) between quadrilateral and hexagonal
(2) between hexagonal and hexagonal
(3) between hexagonal and quadrilateral
(4) between quadrilateral and hexagonal
(5) between hexagonal and hexagonal
(6) between hexagonal and quadrilateral faces

It will be seen further that there are two angles of type A (between hexagonal and hexagonal faces) and four angles of type B (between hexagonal and quadrilateral faces) and these angles of the polygon (a hexagon) sum up to 720 degrees It follows then that

$$A + 2B = 360 \text{ degrees}$$

It must be evident that the volume is stackable if the dihedral angles around any and every line at the intersection of planes can be shown to be three in number, one of which is of type A and two of which are of type B Perhaps at this stage it would be well to heed Millis's advice and construct a model This can be rather easily done by paper-folding, or by taking a fairly stiff copper wire and a pair of pliers and weaving the desired pattern It is then quite easily shown that, when stacked, any line of intersection in the mass is at once the side of an equilateral quadrilateral and of two adjacent equilateral hexagons The dihedral angles are therefore one of type A (hexagon-hexagon) and two of type B (hexagon-quadrilateral).

It should be pointed out that the octahedron should truncate the cube in such a way that equilateral hexagons result, *i e*, all sides of quadrilaterals and hexagons are equal. If this is not done, the 1, 3, 5 sides of a hexagon will not be the same length as the 2, 4, 6 sides Experimentation will show that in stacking the volumes the 1, 3, 5 sides of a hexagon in one figure must coincide with the 2, 4, 6 sides of a hexagon in a second figure, etc. Obviously, if they are of unequal length, this becomes an impossibility and therein may lie a meager basis for Millis's error.

There is no doubt that the figure mentioned by Lewis is stackable [2]

P L. K Gross

Department of Chemistry,
Pomona College

[2] When the letter from Colonel Millis was brought to the attention of Professor W C Graustein, he wrote out a brief mathematical demonstration that Lord Kelvin was right, tetrakaidecahedrons are space filling Meanwhile Colonel Millis, quite independently, had arrived at the same conclusi[illegible] The publication of their letters was not requested [illegible] further treatment of the same subject may be found [illegible]e *Bulletin of the Torrey Botanical Club*, 1927, Vol[illegible] 341–348 —Editor.

EARTHWORMS AND LIGHT

In a previous note printed in Science I have mentioned the effect that ordinary light, such as that emitted by a three-celled electric flashlight, has on earthworms When such a light is thrown at close range on the anterior or pigmented portion of the worm's body it usually causes instant withdrawal of the creature into its burrow. It seems quite possible that sensitivity to light in the earthworms is associated with this pigment, which is of a purplish hue and in sunlight glistens with iridescent color It occurs most densely on the anterior fourth of the body, which region quite obviously is most sensitive to light

Recently I have experimented with lights of various colors to determine the reaction of the worms (*Lumbricus terrestris* Linn), to them and was much interested to discover that light transmitted through a red glass of the sort commonly used for photographic dark-room lamps had no visible effect on them, as apparently they did not perceive it A 40-watt electric light bulb was used in the red lamp and even when this was brought within four inches of the worms they continued undisturbed in their ordinary occupations of feeding and dragging various objects into their burrows. Quite a different reaction was caused by rays from the opposite end of the spectrum, as when a blue light of a dark shade was flashed upon them they withdrew rapidly to the earth. By use of a suitable red light it is possible to observe accurately the behavior of such worms, and I am publishing this information for the benefit of those investigators who are interested in the problem of the origin of the sounds recently discovered to be emitted by earthworms.

W R Walton

Washington, D C.

RESPIRATION OF INSECTS

In Science for May 6, 1927, appeared a note under the above title by D A MacKay The general conclusions drawn in this note would not seem to be warranted by the data presented, especially in view of the fact that contrary results have been reported previously [1] In reference to the idea that in the grasshopper air is alternately inhaled and exhaled through all of the spiracles, the statement is made that "the same thing is probably true of all insects" As a matter of fact in a number of species of insects (the blowfly, Dytiscus and Cybister beetles), in which the mechanics of respiration have been studied, certain spiracles have been shown to be inspiratory and others expiratory.

[1] Lee, M. O, *Jour. Exp Zool*, 1925, XLI, 125

The one experiment described by MacKay which would indicate that the thoracic spiracles serve equally well for inhalation and exhalation, does not seem to be conclusive. In this the head and thorax of a grasshopper were placed under water and the abdomen left out. The bubbles of air which came from around the thorax may have escaped through the injured valve of a spiracle or may have been carried under the water adhering to the waxy chitin. I have made such tests repeatedly on grasshoppers, cockroaches, walking sticks and representatives of every other family of Orthoptera, and have never seen air pumped out of the thoracic spiracles of normal animals. Sometimes when the head and thorax of the insect are thrust under water some air is held around the head and legs. This air may collect as bubbles and float to the surface, and might seem to have come from the spiracles. Also, if the spiracular valves are held or torn open, air bubbles may escape at each contraction of the abdomen. In such an experiment with the head and thorax submerged, the abdominal spiracles which normally open during the collapse and close during the expansion of the abdomen, remain open continuously, evidently serving both for inspiration and expiration. It is true that in such a case the respiratory movements go on and complete asphyxia does not occur. There is, however, some evidence of partial anoxemia in the lessened irritability of the animal.

A few other data bearing on the question might be reviewed briefly. The movements of the valves of the spiracles indicate clearly their actions in inspiration and expiration. The valves of the anterior four pairs of spiracles very plainly open during the inspiratory phase of the cycle (enlargement of the abdominal cavity) and close during the expiratory phase (collapse of the abdomen). The thin, membranous portions of the neck and thorax may be seen to bulge out during each expiration, and this does not occur if the valves of any thoracic spiracles be held open. Further, if the valves of the thoracic spiracles are held open while under water, air bubbles escape at each contraction of the abdomen.

That the abdominal spiracles do not function normally as inspiratory orifices is indicated by the fact that with the abdomen submerged in water, bubbles of air appear over the spiracles and become noticeably larger at each contraction of the abdomen.

The size of the bubble is not noticeably decreased during the expansion of the abdomen, as must surely occur if the abdominal spiracles acted as inspiratory orifices.

MILTON O. LEE

THE OHIO STATE UNIVERSITY

FUNDAMENTALISM IN PHARMACY

PROFESSOR GRIER's letter in a recent issue of SCIENCE has acquainted the scientific public with the change that has occurred in the management of Des Moines University. The issue of *The Gospel Witness* (a publication in the interest of the American Baptist Bible Union) for July 21 contains an account of the investigation of the faculty of the department of pharmacy at the university as follows:

> Two excellent gentlemen were in charge of the college, but the head was a Unitarian. After meeting him we were not surprised to learn that he was very popular with the students. He is a delightful man, whom we all coveted for the Lord Jesus Christ, but, under the circumstances, it became necessary for the faculty to find a new head for the institution.

HENRY LEFFMANN

QUOTATIONS

EPIDEMIC ENCEPHALITIS IN ENGLAND

THE Minister of Health stated the other day, in a written answer to a question, that during the past five years nearly 5,000 persons have died in England and Wales of epidemic encephalitis, the so-called sleepy sickness. During the same period 11,420 cases of the disease have been notified, so that the melancholy fact emerges that nearly half of all those stricken by epidemic encephalitis in this country have succumbed. The fate of those who have escaped death was not referred to by Mr. Neville Chamberlain, but a long series of researches, extending over the known "history" of the disease, suggests that recovery, in the true meaning of that word, is the exception rather than the rule. Epidemic encephalitis leaves behind it, in the majority of instances, damage to body or to brain of a more or less severe kind. As is well known, it possesses the power of transforming character, and this transformation is nearly always from good to bad. It possesses also the power of inducing that form of paralysis known as "Parkinsonism." So grave a malady merits, without doubt, the close attention of the public, especially since it seems to have become established in this country. The Minister of Health pointed out that there were 2,267 fresh notifications of epidemic encephalitis in 1926, 2,635 fresh notifications in 1925, 5,039 fresh notifications in 1924, 1,025 fresh notifications in 1923, and 454 fresh notifications in 1922. The epidemic wave, which reached its highest point in 1924, has therefore by no means subsided, though it has been reduced in magnitude.

It is a temptation in these circumstances to urge that research work on the unknown origins and

means of transmission of this disease should be extended In fact, however, suggestions of this kind are not helpful, because a prolonged and special training is necessary before any scientific worker can address himself usefully to the study of epidemic encephalitis All those who possess the necessary qualifications are at present engaged in one or other of the branches of research which have a bearing on the prevention, causation or treatment of the disease The public has a duty to see that the work now being carried on is not hampered by any lack of resources, but beyond the discharge of that duty it can not properly intervene It can, however, and should, insist that the after-care of the victims of the disease shall be undertaken by those best qualified to conduct it Provision for the care of mental deficiency arising as a consequence of epidemic encephalitis is still woefully inadequate Moreover, the means are not always available to afford persons convalescent from the disease the prolonged and careful attention which they require The London County Council deserves all praise for its effort to provide treatment of partially recovered cases, an effort which has already yielded valuable additions to the knowledge about the disease, but this isolated example of public spirit is not enough As Dr A F Tredgold, speaking on behalf of the People's League of Health, pointed out to the Home Secretary two years ago, it is an urgent necessity to provide an institution where all child victims of epidemic encephalitis, whose minds have been unbalanced, may receive continuous and special treatment The same idea without doubt informed the statement of the medical officer of Brixton Prison in his report for the year ended March 31, 1925, that "we have had one or two post-encephalitic delinquents who resemble congenital defectives in their mental characteristics Those cases are, apparently, hopeless, and it is feared that their number will increase unless some method of curing or protecting against (the disease) is discovered"—*The London Times*

SCIENTIFIC BOOKS

Neuzeitliche Bekampfung tierischer Schädlinge By K. ESCHERICH Berlin Julius Springer, 1927

To Dr K Escherich, of the University of Munich, more than to any other individual is probably due the revival of interest in economic entomology in Germany and its present high standing Under the Carnegie grant, and while he still taught forest entomology at the well-known Forest School at Tharandt, he visited the United States in 1911 and made the studies described in his book "Die angewandte Entomologie in den Vereinigten Staaten" On his return to Germany, he was instrumental in founding the German Society for Applied Entomology and was its first president. His entomological work was largely interrupted by the war, as he was brought into the medical service of the army, but on its conclusion he was transferred to the University of Munich and has been promoting actively the purposes of the new society and furthering the cause of economic entomology in every possible way.

He, with some of the other members of the society, started two admirable journals. He has written many papers and delivered many addresses but none of broader scope and more convincingly phrased than the present one which was delivered before the eighty-ninth meeting of the great German Association of Naturalists and Physicians at Dusseldorf in September, 1926, and which has been reprinted the present year from *Die Naturwissenschaft.*

He gives the great war the credit of showing the German people, thrown practically entirely on their own productive resources, that crops are not gathered in proportion to what has been sown and cultivated, but to what has been left over by the insect pests This is his own expression. Could it be more perfectly put?

As a forest entomologist, it is natural that his illustrations should be drawn from the forest, but the generalizations which he makes apply in many cases to other cultures While in America he became much interested in the subject of natural control, and he dwelt upon the features of this aspect of economic entomology in his book on his American experiences Naturally, as a skilled and broad forester, he thinks of the forest as an entity—as a biocoenosis—and considers philosophically the necessary interrelations of the multitudinous organisms that constitute forest life He draws from these considerations the inevitable conclusion that change of a mixed forest into a one-type forest can not fail to have a most disastrous effect upon certain of the very important elements of the forest's existence, and in working this out he considers especially the interrelations between the destructive insects and their parasites, following out the idea that many of the most important parasites of destructive insects are not specific to one host but have several hosts of differing food plants. Thus, the presence of a certain variety of trees is necessary to insure the supply of some of the most important parasites The reestablishment of mixed forests to replace monocultures is therefore desirable.

In the course of his address he brings out a number of very interesting points. Under the head of parasites, he suggests the desirability of keeping on hand large quantities of strongly polyphagous species which may be reared easily in large numbers. He

states that Haase has been rearing an egg-parasite of the genus Trichogramma in Petri dishes, where it can readily be secured in very large numbers It may be mentioned incidentally that the same idea has occurred to American workers and that insects of the same genus are now being reared in this way in California for use against the codling moth, especially in the walnut groves He treats of the control of insects by diseases, and mentions good results obtained by Schwangart with fungi that destroy the larvae of Cochylis. He also treats of resistant plants and of the desirable qualities of insecticides in general. It is interesting to note that, even before the war, a German forest warden named Zimmerman obtained a patent in Germany on the process of combating insects by means of airplanes, a method which has been developed in this country since the war and which is entering into a promising commercial phase

The address closes with a strong plea to his audience, which he stated comprised the largest forum of German scientists, to turn their attention toward applied entomology and to assist in manifold ways in the work against injurious insects

It is a strong paper and quite worthy of Escherich He realizes that the insect problem is a world problem, and is trying to prove this to the scientific men of Germany

L O Howard

PALEONTOLOGICAL AND GEOLOGICAL INVESTIGATIONS IN THE JOHN DAY REGION OF EASTERN OREGON

A coordinated program of research, rather unique in the range and the detailed nature of the studies included in it, is being conducted in the John Day region of eastern Oregon Through investigations in vertebrate and invertebrate paleontology, paleobotany and physical geology, an attempt is being made to construct as completely as possible the history of the development of animal and plant life and of geologic and climatic changes in this part of the northwest in the later eras of geologic time.

President John C. Merriam, of the Carnegie Institution of Washington, is both directing the project and participating actively in the field and laboratory investigations. The studies are an extension of researches initiated in this region by Dr. Merriam more than twenty-five years ago. The program is being prosecuted under the auspices of the Carnegie Institution of Washington, other institutions which have been cooperating are the University of California, the University of Oregon and the California Institute of Technology.

Mammalian fossil remains in important quantities have been collected in the John Day Basin from three formations, of Oligocene, Miocene and Pliocene age In the thirty-five years beginning in the late sixties quite large collections were made and studied by Condon, Marsh, Cope, Scott, Merriam and Sinclair In the last quarter-century many others have contributed to our knowledge of these faunas, largely through study of materials gathered in the field during the earlier period As part of the present program of research notable additions have been made to the fossil material through further collecting; these furnish an adequate basis for a revision of the faunas from the John Day formation and for a better understanding of the mammalian assemblages from the Miocene and the Pliocene Rattlesnake deposits. These faunas are being studied by Dr. Merriam and by Dr. Chester Stock of the California Institute of Technology, and several preliminary reports are either in preparation or have already appeared In addition to indicating the age and correlation of the formations and aiding in determining the climatic and topographic conditions under which the rocks were deposited, these rather large collections give a vivid picture of the animal life which existed in this region during certain periods of the Cenozoic era.

The paleobotany of the region is being investigated by Dr R W. Chaney, research associate of the Carnegie Institution Large collections of fossil plants have been made and studied, representing the forests and smaller associated plant life of Clarno, John Day, and Mascall time. Results already published contribute to the taxonomy of Tertiary fossil plants, and the ecology of the floras Important interpretations of the fossil plant assemblages have been made on the basis of the ecologic relationships of certain modern floras Significant facts regarding the age and the climatic and other conditions of deposition of the formations which contain them have been brought to light

The invertebrate paleontology of eastern Oregon, especially of the older horizons lying beneath the Tertiary continental deposits, is being studied by Dr. E. L. Packard, of the University of Oregon, who has secured excellent collections of cephalopods and other marine invertebrates Numerous new forms have been recognized in these faunas, and are being described. The last invasion of the sea into eastern Oregon occurred apparently in Chico Cretaceous time, and Dr. Packard is attempting to ascertain from these isolated strata—the only Pacific Cretaceous exposed east of the Cascades—something of the position of the Cretaceous shorelines and the topography and climate of the adjacent land masses Pre-Cretaceous horizons bearing faunas probably not recognized here-

tofore in eastern Oregon have also been discovered and are being studied

Dr Merriam published an excellent summary of the physical geology of the John Day region in 1901 No detailed mapping of the geology had been done, however, before the present program was initiated The region is a key area for the whole northern Great Basin Province in that a larger number of post-Jurassic formations is exposed here than at any other locality In no other district are the great Columbia lava fields dissected so as to expose earlier Tertiary formations so extensively

To facilitate geologic mapping the U S Geological Survey, under a cooperative arrangement with the Carnegie Institution, has made topographic maps of two areas the Mitchell Quadrangle of about 750 square miles, and the Picture Gorge Special Quadrangle of about 56 square miles (on large scale) The writer has finished the geologic mapping of the latter area and has nearly completed the Mitchell Quadrangle The areal and structural studies are as detailed as the scales of the two maps permit

The formations exposed are a pre-Cretaceous crystalline complex, Chico, upper Cretaceous, Clarno, Eocene or Oligocene; John Day, upper Oligocene, Columbia lavas, middle or upper Miocene, Mascall, middle or upper Miocene, and Rattlesnake, Pliocene All the contacts excepting the Columbia lava-Mascall and perhaps the Clarno-John Day are very striking nonconformities Both an exceedingly eventful geologic history and a very interesting series of gemorphic changes are evidenced by the results of the mapping

The investigations in all phases of the John Day program are being continued during the summer of 1927.

JOHN P BUWALDA

CALIFORNIA INSTITUTE OF TECHNOLOGY,
PASADENA, CALIFORNIA

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE STUDY OF RHIZOPUS IN THE GENERAL COURSE OF BOTANY

IN many botanical laboratory courses it is the custom to study bread mold as a mass of hyphae covering bread or some other medium and to mount some of the mycelial mass on a glass slide, teasing it out for further observation of the vegetative structure This method has seemed unsatisfactory, and I wish to suggest another method which has been used with success in the course in general botany at Macalester College.

two glass slides (5 cm × 11½ cm.) are placed several layers of filter-paper of the same size as the glass slides, the interior portions of which have been cut out so as to form a border of filter paper about one centimeter wide A small piece (2 or 3 cu. mm) of the moist bread on which the culture is growing is placed between the glass slides in the center of the band of filter-paper. The slides are then tied together with thread, the filter-paper moistened by dipping the edges of the slides in water and the whole mount placed under a bell-jar In about two or three days the stolonifers will extend outward in various directions from the moist bread, and wherever they come in contact with the glass surface rhizoid-like hyphae and sporangiophores are produced This may now be studied either with the compound microscope or with the binocular microscope

This enables the student to trace the stolonifers with ease from their origin to their attachments to the glass and to study the sporangiophores and rhizoid-like hyphae in their natural positions without any disturbance of the hyphae or any danger of their drying during the study

The above described damp chamber is practically the same as that used by Dr R E Jeffs in his studies of root hair elongation and described in the *American Journal of Botany* 12 577–606, 1925

W J HIMMEL

MACALESTER COLLEGE,
ST PAUL, MINN

SPECIAL ARTICLES

THE VARIABILITY OF LONG DIFFRACTION SPACINGS IN PARAFFIN WAXES

So much interest is being manifested in the polymorphism of long chain compounds, particularly the fatty acids (Piper, Malkin and Austin, *J. Chem Soc* 1926, 2310; deBoer, *Nature*, 119, 50, 635 (1927); Thibaud, *Compt rend* 184, 24, 96 (1927), Müller, *Proc Roy. Soc* 114-A, 542 (1927), that it seems advisable to report the results of some X-ray experiments with ordinary commercial paraffin waxes. Only one mention of X-ray studies of these complex mixtures of many hydrocarbons has been made, that of Piper, Brown and Dyment (*J. Chem Soc.* 127, 2194 (1925) who found that the lines of the C_{26} hydrocarbon appeared alone for a paraffin wax although this fraction furnished only 16 per cent. of the mixture and other members as high as C_{32} were probably present

In the present investigation samples were prepared from waxes melting at 135, 130, 125 and 120° F. by solidifying on glass plates and photographing in an oscillating spectrograph with copper $K\alpha$ rays.

Solidification took place under identical conditions, since cooling from above the melting points to just below occupied 30 minutes Remarkably sharp lines for 3 orders only were obtained corresponding to single long spacings, besides the "side spacing" lines These were all measured with greatest care and checked against photometric curves The results are as follows

Wax m p	d_1	No C atoms indicated	d_2	Side spacings d_3	d_4
135°F	39 42A U	29 0	4 24A.U	3 73A.U	2 56A U
130°	38 58	28 5	4 17	3 73	2 51
125°	35 22	26 0	4 44	3 88	2 44
120°	34 38	25 0	4 23	3 93	2 33

Particular care was taken in the measurement of the side spacings in order to discover any possible regularity in the slight variations running parallel with the change in the principal spacing These were further studied with pinhole diagrams and molybdenum $K\alpha$ radiation There is apparently no such regularity

Some experiments demonstrated that the rate of cooling of the liquid wax film was a determining factor in the spacings The 135° wax was studied further in this respect with the following results

Cooling	d_1	d_2	d_3	d_4
Instantaneous..	36 64A.U	4 12A U	3 82A U	2 58A U
2 min	37 84	4 16	3 82	2 60
10 min	38 24	4 21	3 86	2 63
30 min.	39 42	4 24	3 73	2 56
60 min	40 20	4 13	3 82	2 60

It is evident that the longer the time given the molecules for orientation the greater the spacing for the *same* wax.

The presence of addition agents in small amounts also affects the spacings, when the solidification conditions are kept constant, as shown by the following results on 135° wax with cooling during 10 minutes

	d_1
Wax alone	38 24 A U.
" +1 per cent. α-naphthylamine	38 315
" +1 " " diphenyl oxide	39 75
" +0.5 " " indigo	40 70
" +1 " " Pb oleate	37.5

It is interesting to note that the translucency of the films measured with a Martin polarizing photometer varied directly with the spacings, a property of practical importance in the manufacture of transparent waxed paper The single exception is the wax containing soap Lead oleate itself has a spacing of 37 5 A U and when added to paraffin wax, even in so small amount as 1 per cent, seems to impress its own spacing upon the layers It is still a matter of astonishment, not only that the principal spacing of a paraffin wax may be varied within limits almost at will, but also that these mixtures of as many as 18 hydrocarbons with widely differing molecular lengths form equidistant parallel diffracting layers at all The explanation of the variability of the long spacing for the same wax is complicated by the fact that under different conditions different molecular lengths in the mixture predominate and also varying tilts of the molecules to the diffracting layers are possible

GEORGE L. CLARK

MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
CAMBRIDGE, MASS

CROPS NATURALLY INFECTED WITH SUGAR BEET CURLY-TOP

CURLY-TOP of sugar beets, transmitted by the beet leafhopper (*Eutettix tenella* Baker), has caused enormous losses to farmers and beet-sugar companies in the western part of the United States In California and other western states many beet-sugar factories have been dismantled and moved out of the state, while other mills have been closed permanently or have remained idle during disastrous outbreaks of the disease Unless efficient parasites of the beet leafhopper can be imported and established or a beet resistant to curly-top can be developed, the industry in many localities of the western part of the United States will perish.

In years when a severe outbreak of sugar-beet curly-top occurs, other crops are seriously damaged by the same disease. During the outbreak of the beet leafhopper in 1919 in California, cantaloupes were a failure in the San Joaquin Valley During the past two years cantaloupes have been demonstrated to be naturally infected with curly-top in the Salinas Valley, and the symptoms resembled those observed in the San Joaquin Valley in 1919 Spinach was also found to be naturally infected in 1919, and in many localities in later years

A simple method was adopted in testing plants to determine whether they had been naturally infected.

Leafhoppers which had been non-infective for many generations were fed on stunted diseased plants removed from the field and were then transferred to sugar beets If the beet developed curly-top it was evident that the original plants had been naturally infected with the disease Cross inoculations with non-infective insects fed on healthy crops or weeds grown from seeds or apparently healthy crops or weeds removed from the field failed to transmit the disease.

During the outbreak of the beet leafhopper in Idaho in 1924, a disastrous epidemic disease of beans occurred in Twin Falls County Carsner[1] came to the conclusion on circumstantial evidence that the beet leafhopper may have transmitted curly-top to beans, although he did not see the disease in the field I have demonstrated by the method described above, that a large number of field and garden beans growing in California are naturally infected with, and susceptible to curly-top

During the outbreak of the beet leafhopper in California in 1925, squashes and pumpkins were also proved to be naturally infected with curly-top In 1926, McKay and Dykstra,[2] of the Oregon Agricultural Experiment Station, found curly-top of squash occurring severely in many places in Oregon, Washington and Idaho, resulting in a general failure of squash in the northwest.

It has been known for a long time in California that curly-top of sugar beets and western yellow blight of tomatoes show some correlations In 1919 and 1925, curly-top destroyed most of the late plantings of sugar beets and seriously reduced the tonnage of early plantings in the San Joaquin and Sacramento Valleys, and interior regions of the Salinas Valley; in the same years western yellow blight of tomatoes destroyed most of the crop in the same valleys Both diseases are subject to regional variations, being more severe in the natural breeding areas of the beat leafhopper in the San Joaquin and Salinas Valleys than in the coastal regions

During 1925 and 1926, non-infective beet leafhoppers after feeding on tomato plants affected with western yellow blight transmitted curly-top to sugar beets Curly-top was also transmitted from tomatoes showing symptoms only of mosaic, this transmission to beets demonstrated that the tomatoes were also naturally infected with the causal agent of curly-top

Recently McKay and Dykstra[3] came to the conclusion on the basis of circumstantial evidence that western yellow blight of tomatoes is caused by the virus of sugar beet curly-top They state that typical symptoms of western yellow blight developed in the greenhouse by infecting tomatoes by means of the beet leafhopper.

The following crops have been found to be naturally infected with curly-top in California

CHENOPODIACEAE, GOOSEFOOT OR SALTBUSH FAMILY

Sugar Beet (*Beta vulgaris*)
Beta maritima.
Mangel Wurzel or Stock Beets (*B vulgaris*) Giant Yellow, Golden Tankard, Half Sugar, Mammoth Long Red, Red Eckendorf, Yellow Eckendorf and Sludstrup
Garden, Table or Red Beets (*B vulgaris*)
Swiss Chard (*B vulgaris cicla*)
Spinach (*Spinacia oleracea*) Bloomsdale Savoy

LEGUMINOSAE, PEA FAMILY

Field and Garden Beans. Bountiful, Cranberry, Kentucky Wonder, Long Red Kidney, Small White, String less Green Pod, White Seeded Kentucky Wonder (*Phaseolus vulgaris*), Baby Lima or Henderson Bush (*P lunatus*) and Blackeye (*Vigna sinensis*)
Alfalfa (*Medicago sativa*) · Hairy Peruvian

CUCURBITACEAE, GOURD FAMILY

Pumpkins and Squashes White Scallop, Summer Crookneck, Delicata (*Cucurbita pepo*) Chicago Warted Hubbard (*C maxima*) Winter Crookneck and Banana (*C. moschata*)
Watermelon (*Citrullus vulgaris*) · Klondyke and Excell
Cucumber (*Cucumis sativus*) Early Fortune, Long Green and a variety either Chicago Pickle or Long Green
Muskmelon (*C melo reticulatus*) Green Nutmeg, Pol lock and Tip Top
Cantaloupe (*C melo cantalupensis*): Salmon Tint.

SOLANACEAE, NIGHTSHADE FAMILY

Potato (*Solanum tuberosum*) · Unknown variety
Tomatoes (*Lycopersicon esculentum*) (Curly-top was transmitted to sugar beets from tomatoes affected with western yellow blight and mosaic)
Peppers. Anaheim Chili (*Capsicum frutescens*), Paprika (*C. annuum*); Pimento (*C. annuum, C. annuum perfecto*) and Mexican Chili (*C frutescens*).

CRUCIFERAE, MUSTARD FAMILY, CRUCIFERS

Horse-radish (*Armoracia rusticana*).
Radish (*Raphanus sativus*). Variety questionable, probably Red Globe.
Garden Cabbage (*Brassica oleracea capitata*). Unknown variety.
Turnip (*B. rapa*): Purple Top Globe.

UMBELLIFERAE, PARSLEY FAMILY

Plain Parsley (*Petroselinum hortense*).

HENRY H. P. SEVERIN

[1] *Jour Agr Res*, 33 345–348, 1926
[2] *Phytopath*, 17 39, 1927
[3] *Phytopath*, 17 48–49, 1927

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PHYSICAL INDETERMINISM AND VITAL ACTION

Science and philosophy, but especially science, have found great difficulty in reconciling the apparent indeterminism of many vital manifestations, particularly voluntary action, with the strict determinism of physical science The traditional problem of freedom, with all its vast implications, is the classical expression of this difficulty. One characteristic aspect of this problem seems peculiarly significant, especially when considered in relation to the present state of discussion on the foundations of physical science. This is the qualified nature of freedom as expressed in external action, there is always a large element of restriction or external determination. No one has claimed that vital indetermination is complete, although Bergson speaks of the living organism as exhibiting a maximum of indetermination[1] To take a simple illustration the evidence for levitation is doubtful, even its most accomplished exponent would hesitate to launch himself from the edge of a cliff, however firmly he might be convinced of the freedom and efficacy of his own will And he would continue to rely daily on the mechanical dependability and physically determined regularity of his own bodily organism I allude to this inconsistency with no merely satirical intention, but simply in order to define as clearly as possible a crucial aspect of the problem It is undeniable that the organism is subject to rigid physical determination in a large part of its activities, it seems equally undeniable that it is free in others, the difficulty is to decide where determinism ends and indeterminism begins. Intuition gives an overwhelming impression of freedom in voluntary action. Yet analysis, in tracing down the sources of such action, seems always to reinstate determinism; it shows the will to be motivated, motives have their natural origins, actions not consciously motivated either are habitual and referable to past motivation, or are instinctive and determined by heredity. In either case we seem to have a mechanistic determination. Physiology finds in the organism a nexus of physico-chemical determination differing from that in non-living nature only in its complexity, in fact the organism can be shown to depend for its survival on the constancy and stability of its proc-

[1] "Creative Evolution," English translation, Chapter 2; cf. e.g., p. 126.

esses, *i e*, on their strict physical determination Although voluntary action effects mechanical change and seems free, the "energy balance-sheet" of a man shows no conflict with the law of conservation, indicating that there is no creation of energy within the organism It might be held that the will can direct energy even if unable to create it, but since by Newton's first law force is required to change the direction of a motion as well as to initiate it, we must conclude that a system unable to create energy would be equally unable to direct it arbitrarily Classical physics thus seems definitely incompatible with the idea of freedom, accordingly scientific men—and somewhat curiously biologists in larger proportion than physicists—have commonly regarded freedom as a delusion In so doing they may have created more difficulties than they have resolved, certainly the inner conviction of freedom has not been abolished in the minds of most thinking men But if we accept freedom as a fact, we are bound to consider whether at least a certain measure of physical indeterminism may not also be a fact Such a residue of indeterminism, if it could be shown to exist, would conceivably explain the indeterminism or inner freedom seen in voluntary action, the evidence for its existence thus becomes a matter of great biological and philosophical interest

When we inquire into the special physical peculiarities of living as distinguished from non-living systems we are struck by the fact that in the former the determining and controlling events are invariably on an extremely small scale[1a] The microscope is the chief instrument of biological investigation In this respect biological phenomena are at the opposite pole from astronomical phenomena In the latter the possibility of exact prediction attains its maximum, in vital phenomena, on the other hand, prediction is possible only within certain limits, variability seems inherent, indeed in the highest manifestations of life prediction is not possible at all It is especially such manifestations that we call "free." Such considerations suggest the question do events cease to be predictable and become free when their spatio-temporal scale becomes sufficiently small? At least we must regard it not as a coincidence but as highly significant that the only region where physical science gives evidence of experimental indetermination, *i e*, of externally uncontrolled or individual action, is in the field of ultramicroscopic phenomena At present quantum phenomena are the subject of debate as to the universality of the rule of unequivocal physical determination[2] Even on the relatively large scale of Brownian movement any single configuration of a group of particles is as possible as any other, although the different configurations differ in probability In other words, a given special configuration or grouping is determined by conditions of probability rather than by definitely assignable physical causation It is well known that Maxwell and Boltzmann have ascribed a purely statistical significance to the second law of thermodynamics, and Svedberg's observations on Brownian movement, confirming the theoretical deductions of Einstein and Smoluchowski, have shown experimentally that within a sufficiently small space and time the second law does not necessarily hold[3] It follows that the regularity of macroscopic phenomena, in which determinism is for all practical purposes complete and trustworthy, is in reality a statistical regularity[4] We are not justified in ascribing a similar regularity to single events in the ultramicroscopic field To a given macroscopic arrangement or condition any one of an infinite number of detailed microscopic configurations may correspond Our microscopic picture of the world is not complete, but it already seems clear that many of the physical laws with which we are familiar in the realm of macroscopic phenomena cease to apply on the scale where events are determined by quantum relations or by the "chance" fluctuations of molecular movement Ultramicroscopic phenomena thus give evidence of an ultimate indetermination (defining determination in the usual physical sense of quantitative specification of conditions), *i e*, of control by individual action rather than by statistical or mass action[5] The laws relating to such action—assuming such laws to exist—are as yet imperfectly known, but they are certainly entirely different from physical laws as hitherto understood

Direct evidence of physical indetermination or freedom is thus to be sought primarily in the behavior of individual particles in the ultramicroscopic field; derivatively, however, we may expect to find it in processes of a larger scale, *provided* these processes are in some way controlled by the ultramicroscopic events Now vital processes appear to be processes

[1a] *I e*, small relatively to the scale of human sense-perception and adjustment.

[2] *Cf* P Jordan "Philosophical Foundations of Quantum Theory," *Nature*, 1927, vol 119, p 566

[3] *Cf* T Svedberg "Colloid Chemistry," New York, 1924, pp 118 *seq* "It is obvious that in microscopic systems fluctuations of entropy occur" (p 120).

[4] See the recent interesting book of Professor C E Guye, "Physico chemical Evolution," New York, 1926

[5] *Cf* F G. Donnan: "Concerning the Application of Thermodynamics to the Phenomena of Life," *Journ Gen Physiology*, 1926, Vol. 8, p. 685· also *Scientia*, 1918, vol 24 (2), p. 281.

of just this kind. Living systems are peculiar among the systems of nature in that their characteristic behavior is determined primarily by internal activities of a microscopic or ultramicroscopic kind, as a rule it is only secondarily, as a result of the characteristic "irritability" of living matter, that events in the external world affect the vital processes This peculiarity is an incident of the special type of physico-chemical constitution characteristic of living protoplasm Without attempting to characterize the protoplasmic system completely, I would here call particular attention to certain features which are especially relevant to the present discussion Both the structure and the activity of the system are expressions of its specific chemical activity or metabolism, *i e*, of the continual chemical interaction of its component molecules, the synthetic production of new and complex compounds is an especially characteristic feature This complexity (*e g*, of proteins) is itself important, because it implies large molecular weights, and the element of indetermination, in the above-defined sense, is greater (for a given mass of material) when the molecules are large than when they are small, since they are then fewer in number and there is less chance (in the statistical sense) of an individual action being rendered ineffective as a consequence of the law of large numbers Individual molecular action may thus become an important factor in the determination of processes in the system [6] This, put briefly, appears to be the essential difference between a living organism, considered as a purely physico-chemical system, and a machine of the usual macroscopic construction.

With regard to the general nature of the conditions determining the special activities of the two types of system, the essential contrast is that between an inner or ultramicroscopic determination of action and an external or mechanistic determination The ultimate living units (biophores, genes or other physiological units) are characteristically minute, of dimensions corresponding to those in which the range of Brownian movement may be of decisive importance in the momentary behavior of the system. It is thus conceivable that under certain circumstances a single localized extreme oscillation, determined by conditions that can only be described as individual, may form the occasion of a change, *i.e.*, may initiate a process, which will determine the activity of the whole system

How is it possible that an event on such a minute scale can affect the total activity of a system of microscopic or even of macroscopic dimensions, such as a cell or a larger organism? Are not the chances that its effect will be internally compensated by similar oppositely directed effects the same as in any non-living system? To understand the conditions we must recall what is implied in the general property of *irritability*, universally characteristic of living matter The response to any stimulus implies the transmission of an activating influence from the localized site of stimulation throughout the larger functional area concerned in the response In other words, the protoplasmic system is characterized by a highly developed power of transmission Its irritability is inseparable from such transmissivity, and it is this latter property that renders possible the kind of centralized control under consideration In general, protoplasmic activities are controlled by processes of a spreading kind, which as such necessarily involve amplification It thus becomes possible for an activity initiated locally in the ultramicroscopic field of the cell or organism to spread to surrounding areas and in so doing to become indefinitely magnified in extent so as to involve the macroscopic field and determine the activities in the latter Just as the pattern described by the fluctuations of a minute electric current in a telephone system may be reproduced by thermionic amplification in all of its original details but on a vastly larger scale, so the process corresponding to some local activity in the ultramicroscopic field of the living system (*e.g*, in certain molecules of the nerve cells) may by a spreading action be reproduced—whether in a literal or a representative sense—over a much larger area and express itself in the macroscopic activity of the whole system

To illustrate the case in a somewhat more concrete manner a human action, appearing entirely spontaneous and voluntary (free) to both actor and observer, would, if analyzed physiologically, exhibit itself as a succession of mechanistically determined events in all of its macroscopically observable details Its special *quale* would, if traced down into the finest possible detail, finally appear as dependent upon certain ultramicroscopic events in the nerve cells. What should especially be noted is that when these events were finally reached in the analysis no further definite physical determination could be assigned The events might in fact not be physically determined —in the sense in which classical physics defines determination—but be examples of indeterminism, *i.e.*, of "free" or externally uncontrolled individual action Regarding the conditions of such action science has little to say at present The difference between mechanist and vitalist would then narrow down to the question of how far the *initiatory* process was physically determined or "free." No one would dispute that the macroscopic processes were unequivocally determined or mechanistic, but the inner determina-

[6] *Cf.* the calculation in Donnan's recent paper, *loc. cit.* (1926).

tion in the ultramicroscopic field might quite properly be called free The question of what physical meaning could be assigned to the term freedom would then arise. Briefly, an internal or individual rather than an external determination would seem to be the essential character implied

The distinction we are emphasizing is essentially that between the conditions determining macroscopic processes, which according to Maxwell and Boltzmann are determined statistically, and those determining single ultramicroscopic events where individual determination prevails A smoothing-off or obliteration of inner detail is inevitable in effects controlled by mass action, which as observed represent the sum or integration of numerous fluctuating minutiæ. The relation between a smoothed curve and the distribution of the points showing the individual data is a relation of a similar kind The inner processes which acting as an assemblage or collectively produce a certain mechanical or other effect might, individually considered, be free Compare the analogous case of the curves representing the frequency distributions of human voluntary acts like suicide, predictions made on the basis of such curves are reliable if the number of individual cases is sufficient, and the behavior of such a population might seem mechanically determined [6a] For an essentially similar reason physical determination in the macroscopic realm appears unequivocal and freedom entirely absent If, however, we consider a system in which single individually determined or "free" ultramicroscopic events—whether Brownian movements, quantum phenomena or something still more ultimate—are in some way enabled to control effectively the macroscopic events in the system, the latter would also appear (to that degree) to be externally uncontrolled or free.

It seems highly probable that the conditions in living organisms are actually of this type. Evidently an inner control of the kind imagined would be possible only in a system with highly developed transmissive properties The living organism is, however, just such a system Experimentally it is easy to show that an event of microscopic extent and duration, *e g*, a properly localized electric shock or a pinprick, may determine the activity of the whole system Consider also the relation between the retinal processes and the activities which they control. Such large physiological effects depend, as just indicated, upon the peculiar type of transmission characteristic of living matter—spreading of chemical influence associated with amplification. The degree of the spreading and of the resulting amplification (which may be intensive as well as extensive) is limited only by the distribution of the tracts or surfaces over which the spreading can take place and by the nature of the physiological mechanisms which are thus activated In higher animals and man these transmitting tracts are represented mainly by the minute and extensive ramifications of the nervous system, which control muscular and other action. In the single nervous element or cell the transmissive process appears to consist essentially in a chemical and structural alteration of the interfacial films at the protoplasmic phase-boundaries. Transmission of chemical influence to a distance by means of the local electrical effects resulting from the alteration of interfacial films is well known in inorganic chemistry—the case of passive iron and similar systems—and shows many close analogies with protoplasmic transmission [7] Incidentally it may be pointed out, as a special condition favoring *indetermination* (independence of mass action) in systems having this type of transmission, that these films may be monomolecular in thickness, the local ultramicroscopic surface-area where the activity is initiated thus contains fewer molecules than would be the case if the molecules were distributed in three dimensions, and the chance that a single large fluctuation may become effective is correspondingly increased

It is important to note that the transmissive process itself (*e.g*, nerve impulse), being on a relatively large scale, belongs in the class of phenomena dealt with by classical physical chemistry. Hence it is limited in its possible range of variation by thermodynamic conditions of the usual kind; correspondingly it is unequivocally regular or determined in its physical character. It is clear that the chain of processes intervening between the physically undetermined initiatory event and the large-scale organic action must themselves be rigidly determined in character and interconnection, otherwise any precise or regular control would not be possible. In fact, voluntary control is precise to a remarkable degree—as all acts of skill testify—limited only by the physical capabilities of the organism

An example from the inorganic field, showing how large external effects may be without assignable external causes, may illustrate perhaps more clearly the general nature of the conditions. Every now and then an unexplained explosion occurs in stores of high explosives. We know from observation of Brownian movement, as well as from theoretical con-

[6a] *I e*, to an observer whose scale of perception did not permit discrimination of inner detail

[7] *Cf* my recent volume, "Protoplasmic Action and Nervous Action," University of Chicago Press, 1923, for an account of this type of transmission.

siderations of probability, that at infrequent intervals an internal molecular or particulate movement of unusual amplitude occurs. Such a movement may exceed the critical minimum below which no chemical reaction results, but if such a reaction should take place locally the whole mass would be ignited by transmission of the explosive type. Explosions due to purely spontaneous activity are thus to be expected in large masses of explosive at intervals; such intervals may be calculable, and the matter might well be tested experimentally, using known volumes of mechanically sensitive explosive kept at appropriate temperatures. A local mechanical shock will set off such a mass, and conceivably an internal particulate movement of large amplitude might have the same effect.[8] The spontaneous activation which occurs in passive iron wires kept in dilute nitric acid—with a frequency increasing with dilution, size of wire and temperature—is an example of a similar condition, also suitable for statistical investigation.

In the living organism the microscopically visible structure shows a definite correspondence with the requirements of the present view. In broad outline we seem to perceive the character of the nexus through which submicroscopic events are enabled to control microscopic and ultimately macroscopic events. It is clear from general considerations that a heterogeneous system such as protoplasm is favorable to a centralized type of control of the kind indicated.[9] Experimental studies lead to a similar conclusion. Modern genetics indicates that submicroscopic particles (genes) determine the special details of inheritance;[10] in an analogous manner minute local stimuli determine the activation of extensive physiological mechanisms, and minute areas of active growth determine the form adopted by the growing embryo. Just as submicroscopic events thus determine microscopic events, so behind or internal to the submicroscopic events we must assume a series of ultramicroscopic events reaching back by convergence into the field where the known types of physical determination are replaced by another type of determination, the special conditions of which we do not know. Apparently, however, this type contains possibilities of a kind entirely different from those with which we are familiar from our experience of large-scale phenomena. In this field events occur which appear to be free, *i.e.*, internally rather than externally determined, although we can as yet give no scientific account of the conditions of such determination.

We may now briefly consider the question: how are we to conceive the conditions of action in the remote ultramicroscopic field where physical determination, as hitherto understood, seems to fail? This field, beyond the range of the classical or deterministic physics, is now, thanks to the methods of the new physics, open (in part) to experimental investigation. One may therefore hesitate to call it the ultraphysical field—still less the metaphysical. Probably it can be characterized satisfactorily only on the basis of future research. It would seem, however, that there must be some final support or substratum of the physical to which only the term metaphysical can be applied. The question becomes: is action in this field free? and if so what is meant or implied by the term? Two possibilities suggest themselves. If by free we mean externally uncontrolled, it would appear that the ultimate local centers or units of action should be independent of one another, *i.e.*, a radical discontinuity should exist at the basis of physical reality. Something of the kind seems to be indicated by quantum phenomena. There is also the general philosophical position that the universe, considered in its totality, must be the expression of free action, since an all-inclusive whole can not be determined externally, *i.e.*, by conditions outside itself. How otherwise are we to account for its having the special and arbitrary character which it actually does have, instead of any other one of the infinity of possible alternative characters? Claude Bernard, indeed, while working actively in experimental physiology, referred the ultimate vital determination to the metaphysical world. In this world, he considered, freedom was possible, although in experimental biology he insisted on a rigid determinism.[11] What is significant is that in both of the possibilities just considered an ultimate determination other than physical is implied, but without infringing the usual types of physical determination.

It may be objected that (*e.g.*) intra-atomic phenomena are not undetermined, but are determined according to laws which are still physical laws, however different they may be from those prevailing in the macroscopic or mechanical sphere. The stability

[8] For a discussion of the chances of appreciable mechanical effects resulting from Brownian movement, *cf.* the recent book of Professor G. N. Lewis, "Anatomy of Science," Yale University Press, 1926, p. 145. Incidentally the case of levitation comes in for consideration.

[9] *Cf.* the discussion in Guye's "Physico-chemical Evolution," p. 136.

[10] Freundlich has considered the possibility that fluctuations in the Brownian movement of the genes may lie at the basis of mutations: *Naturwissenschaften*, 1919, Vol. 7, p. 832.

[11] *Cf.* the recent English translation of Bernard's book on "Experimental Medicine," Macmillan Co., New York, 1927.

of an atomic system in itself implies strict determinism. Our amended conclusion therefore would be that events are determined, in the sense of being subject to law, in the ultra-mechanical as well as the mechanical world, but that the conditions of this determination are fundamentally different. The term "physical indeterminism" might by some be regarded as a misnomer We seem, however, to have reached a stage in scientific development where physical terms are acquiring unexpected meanings, the present contention would simply be that the older physical conceptions of determinism may not prove applicable to the new range of phenomena, and that the experimental facts themselves may oblige us to admit the existence of determining factors indistinguishable in essence from those which formerly we called free This, however, is not a philosophical but a scientific paper, and my present aim is simply to indicate an objectively valid source of determination for certain fundamental vital phenomena which hitherto have proved refractory to analysis.

RALPH S LILLIE

MARINE BIOLOGICAL LABORATORY,
JUNE, 1927

HENRY PAUL TALBOT

THE death of Dean Henry Paul Talbot deprives the institute of the services of one of its most cherished alumni, one who devoted his life in a noteworthily unselfish way to the upbuilding of his Alma Mater. For forty years he gave the best of his brain and heart to the development of teaching and administration and to the advancement of the Massachusetts Institute of Technology as a great school of engineering and science

Dr Talbot graduated at the institute in 1885 and received the degree of doctor of philosophy from the University of Leipzig in 1890 He returned to the institute as an instructor and was rapidly promoted through the several grades and was finally appointed professor of analytical chemistry in 1898 He showed marked administrative ability and from 1895 was nominally in charge of the department of chemistry, although his official appointment to this post was not made until 1901 He served as chairman of the faculty from 1919 to 1921, as chairman of the administrative committee from 1920 to 1923 and as dean of students from 1921

Dr Talbot's training in chemistry was broad: his work as a student equipped him with the point of view of the analytical chemist, his research for his doctorate was in organic chemistry, and he devoted much attention to the study in Germany of the new physical chemistry which was being rapidly developed at that time He was impressed with the importance of the advance of the science in this direction, and on his return from Germany he introduced at the institute a course in physical chemistry, which he taught successfully This course was one of the first in this subject given in American universities

When Dr Talbot took over the instruction of the first-year students, he felt the advisability of bringing before them the more fundamental concepts of the newer chemistry He accordingly prepared, with the assistance of Professor Arthur A Blanchard, a text for this purpose entitled "The Electrolytic Dissociation Theory" Professor Talbot's progressive action in these two cases is typical of his attitude in educational affairs He was the leader in the development of his department to its present efficient condition and served as chairman of committees on chemical education in the American Chemical Society and the Society for the Promotion of Engineering Education He showed unusual interest in the teaching of high school science and was helpful in organizations devoted to the improvement of teaching in this field He served as president of the New England Chemistry Teachers' Association and was for several years chief examiner in chemistry of the College Entrance Examination Board

Dr Talbot's record as a member of the American Chemical Society brought to him the honor of election as one of the five directors who determine the more important policies of the society and have full charge of its finances He has been a member of the council since 1898, he served as associate editor of the *Journal* of the society and as chairman of the division of inorganic and physical chemistry He also was a member of many important committees

During the world war Dr Talbot was appointed a member of a small committee to act in an advisory capacity to the Bureau of Mines in the work it had undertaken in correlating the chemical activities of the country to meet the problems arising from gas warfare. He was particularly helpful in presenting to the Secretary of War directly the needs of this organization, which carried on for over a year, outside of the war department, all the work on war gases.

Dr Talbot was always interested in research In the years following his return from Germany he published the results of several investigations in the field of inorganic and analytical chemistry For a number of years he was chairman of the committee of the American Academy of Arts and Sciences that has charge of the C M Warren Fund, the income of which is devoted to aiding chemical research. In recent years the small amount of time available, after he had completed his work as a teacher and administrator, was devoted to editorial work and the writing

of papers on educational, scientific and industrial subjects. He is the author of a widely used text-book on quantitative analysis. Professor Talbot was the consulting editor of the International Chemical Series, which comprises books on a wide range of subjects in the field of chemistry. During the war the *Atlantic Monthly* published a series of papers by him on gas warfare. These were written in the interesting and lucid style which is characteristic of all of his writings. As chairman of the faculty, and of the administrative committee after the death of President Maclaurin, Professor Talbot had much to do with shaping the recent policies of the institute.

Professor Talbot's work has always been appreciated by chemists. Dartmouth College gave him the honorary degree of doctor of science in 1921. In bestowing the distinction his record was summed up as follows: "Henry Paul Talbot—administrator and scholar, faithful and versatile contributor to the welfare of a distinguished sister institution of high learning, scientist whose interest in the discovery of new truths is matched by instinct for the application of those truths, of whose knowledge you have possessed yourself, by virtue of the authority vested in me I welcome you to the fellowship of Dartmouth men and I confer upon you the honorary degree of doctor of science."

In the midst of all his scientific, educational and administrative activities Dr. Talbot consented to accept the important appointment of dean.

Dr. Talbot always showed a keen personal interest in the students as individuals. One of my colleagues, in pointing out the cordial relationship that existed between Professor Talbot and the students who knew him well, noted the fact, evident to us all, that he retained the spirit of youth. To the younger members of the department which Dr. Talbot directed for so many years, his life was always an example of loyal devotion to an ideal, every official act was the result of a conscientious and unselfish desire to do what was best for the Massachusetts Institute of Technology. His will, filed for probate just before this was written, expressed in a concrete way his interest in these younger men and in the institute. He names the institute as a residuary legatee and suggests, but does not require, that a part of the whole of the bequest be used to assist junior members of the institute's staff to attend meetings of the societies of their professions.

JAMES F. NORRIS

SCIENTIFIC EVENTS

TOPOGRAPHIC MAPS OF WESTERN NATIONAL PARKS

Two topographic maps of western national parks have been published by the Geological Survey of the Department of the Interior, one is a map of an area including the Sequoia and General Grant National Parks, California, and the other a map of the east half of the Grand Canyon National Park, Arizona.

The maps are printed in three colors—black showing the works of man, blue showing the rivers and other water features and brown showing the contour lines of altitude that are the distinguishing features of a topographic map. Both maps appear almost like relief models of the areas they portray.

The Grand Canyon map includes the part of the Grand Canyon extending from its head southward and westward to Crystal Rapids and bounded on the north by the Kaibab Plateau, on the east by the Painted Desert, and on the south by the Coconino Plateau. The great contrasts in topography between the canyon slopes and the surrounding plateaus and those between the walls of the main canyon and of the Granite Gorge are clearly shown. The sculptural details of the canyon walls, as well as the buttes and the temples that stand out from the main slopes, are faithfully represented on the map, and the fact that the surface of the Coconino Plateau descends southward away from the canyon rim is well shown along the southern margin of the map. The numerous rapids along the Colorado River are indicated by symbols, and the location of the trails, camps and springs are shown. The Grand Canyon map measures 41 by 65 inches and is sold by the Geological Survey at 25 cents a copy.

The map of the Sequoia and General Grant National Parks embraces an area in eastern California, situated mainly in the Sierra Nevada, and includes these two parks, the Sequoia National Game Reserve, and considerable portions of the Sequoia, Sierra and Inyo National Forests. The northeast corner of the area lies in the Inyo Mountains, and the east side is crossed by Owens Valley, whose floor is shown to lie some 3,700 feet above sea-level. West of Owens Valley the great eastern wall of the Sierra rises abruptly 5,000 to 7,000 feet and is topped by many summits that stand 12,000 to 14,000 feet above the sea. Among them is Mount Whitney, 14,501 feet, the highest point in the United States. The western slopes of the Sierra, which occupy the greater part of the area shown on the map, are seen to be deeply trenched by the rugged canyons of Kings, Keweah and Kern Rivers—the Kings River canyon one of the deepest in the world. This part of the area abounds in gorges, domes, alpine meadows, glacial cirques and cirque lakes, there being several hundred small lakes among the higher summits and divides. The area also contains a dozen groves of the "Big Trees." This map measures 32 by 29 inches and may be obtained from the U. S. Geological Survey, Washington, D. C.

STANDARDS FOR SCIENTIFIC AND ENGINEERING SYMBOLS AND ABBREVIATIONS

THE decision to undertake the standardization of scientific and engineering symbols and abbreviations as a national enterprise was made at a general conference called by the American Engineering Standards Committee and held in the rooms of the American Society of Mechanical Engineers on February 13, 1923 Three organizations, the American Institute of Electrical Engineers, the Association of Edison Illuminating Companies and the American Society of Mechanical Engineers, made the original recommendations which resulted in the calling of this conference Official representatives of national organizations attended this conference and after a full discussion they voted unanimously that this project should be undertaken, and that the American Association for the Advancement of Science, the National Research Council, the Society for Promotion of Engineering Education and the U S. Bureau of Standards should be requested to accept joint sponsorship Later the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Society of Civil Engineers were invited to become joint sponsors

The sectional committee on scientific and engineering symbols and abbreviations now consists of thirty members representing thirty-seven national organizations It has organized nine subcommittees to which have been assigned the following divisions of the subject, (1) Symbols for Mechanics, Structural Engineering and Testing Materials, (2) Symbols for Hydraulics, (3) Symbols for Heat and Thermodynamics, (4) Symbols for Photometry and Illumination, (5) Aeronautical Symbols, (6) Mathematical Symbols, (7) Electrotechnical Symbols including Radio, (8) Navigational and Topographical Symbols, (9) Abbreviations for Scientific and Engineering Terms The reports of these subcommittees will be prepared and issued separately

Mathematical Symbols The proposed standard for Mathematical Symbols was developed by Subcommittee No 6, of which Mr Edward V Huntington, professor of mechanics, Harvard University, is chairman A draft of this subcommittee report was considered at a meeting of the executive committee of the sectional committee in January, 1927, and was approved, with slight amendments, which subsequently were introduced into the report by the subcommittee The report was submitted to the members of the sectional committee on April 25, 1927, and received its approval. A few minor suggestions for modification were submitted by individuals, but it has been considered inexpedient by the sectional committee to reopen the whole matter for consideration of these few individual suggestions.

They are, therefore, included as an "Appendix" to the report, with the recommendation that when the report shall be reconsidered for revision they shall receive due consideration The proposed standard is now before the five sponsor bodies for their approval and transmission to the American Engineering Standards Committee for approval.

Aeronautical Symbols. Subcommittee No 5, Professor Joseph S Ames, the Johns Hopkins University, chairman, has taken advantage of the early work of the National Advisory Committee on Aeronautics The list of approximately 100 letter symbols which it now proposes for criticism and comment have for the most part been in use by the National Advisory Committee for the past few years

This report of the subcommittee was approved by the executive committee of the sectional committee, January 22, 1927, subject to possible modification by the executive committee after consideration of conflicts and duplications in symbols The attached statement of conflicts and duplications in symbols was considered by the subcommittee, after which the original report was reaffirmed on April 19, 1927 The subcommittee report is now issued in tentative form with a request for criticism and suggestion from all concerned. Communications may be directed to Preston S Miller, secretary of the sectional committee, Eightieth Street and East End Avenue, New York, N. Y

FLOOD CONTROL BY REFORESTATION IN MISSISSIPPI

AN extensive survey under which will be brought together all available information upon the location and area of forests needed on the Mississippi watershed as a part of flood prevention and control has been started by the Forest Service of the United States Department of Agriculture and will be completed by early fall.

"The survey," says Col. William B Greeley, chief forester, "will define the main tributaries of the Mississippi to be treated as units, and for each of these tributaries data will be brought together on the acreage, the amount and character of the precipitation, the more essential or more common soil classes, features of physiography, including ruggedness of topography, natural reservoirs, etc, the general character of the vegetative cover, and a rating of the value of the protective cover as a means of flood prevention and control"

The object of the survey is to bring out on this enormous drainage basin the area or watersheds where, on account of rainfall, character of soil, topog-

raphy, etc., forest cover has an important protective value.

Considering especially character of soil, steepness of slope, and character of precipitation, a rating will be given the protective value of forest cover as an element of the particular watershed The plan is to eliminate watersheds where on account of these factors the maximum protective influence that a forest might exert would have a comparatively minor effect upon stream and flood conditions, and to locate the areas where, because of soil, topography and precipitation, the effect of forest cover would be important

A somewhat similar rating of the protective efficiency of the existing forest cover on the Mississippi system's watersheds is proposed The plan contemplates putting all this data as far as possible on a set of maps for ready consultation in the formulation of comprehensive plans for flood prevention and control in the Mississippi Valley The data obtained by the Department of Agriculture through the Forest Service will be correlated with that of the War Department and other agencies for the construction of reservoirs and other engineering methods of flood control

E A Sherman, associate forester, has been named the direct the survey

THE FIELD MUSEUM OF NATURAL HISTORY

Extensive engineering changes are being made in Field Museum of Natural History As a result of this work, fourteen large additional halls will be made available for museum exhibits, and the heating of the new Shedd Aquarium, the stadium in Soldier Field and the museum itself will be centralized in the Field Museum's heating plant For more than a year past the museum has been supplying heat to the stadium, and an arrangement was recently entered into between authorities of the projected Shedd Aquarium and the museum to supply heat to the new institution

Of the halls gained for public exhibits in the museum by the changes being made, eleven will be devoted to anthropological collections, and three to zoological subjects The work is being rushed in the hope of completing it by October 1 Shortly after that date, it is expected, operations for installation of collections in the new halls will begin, and as soon as each hall is arranged with its exhibits it will be thrown open to the public. The entire fourteen new halls probably will not be in use until a considerably later date.

The continued development of Field Museum as an institution of world importance, and the constant flow of accessions of valuable material in all four of its departments—anthropology, botany, geology and zoology—through expeditions sent out by it, and through gifts of its friends, have made more space an absolute necessity

The halls to be gained are on the ground floor of the building, and will constitute about two thirds of the 245,000 square foot area of this floor All pipes and other obstructions, which have made this space unavailable for exhibits in the past, are being removed Steam and water pipes, now running along the ceilings, will be carried through underground trenches and tunnels, increasing the headroom of the halls and bettering their appearance The pump room on the ground floor will be depressed

The new halls will enable the museum to have a well-ordered geographical and scientific arrangement of the anthropological collections Among exhibits planned for these halls are those from Melanesia, the Philippine Islands, Malay Peninsula and Malay Archipelago, Polynesia, Micronesia, Madagascar and East Africa, North, West and South Africa, India, Egypt and Mesopotamia Their installation in the new halls will make it possible to devote the entire east wing of the main floor exclusively to North, Central and South American archeology and ethnology One of the new halls will be devoted to exhibits illustrating the progress of prehistoric man, for which Henry Field, assistant curator of physical anthropology, is now collecting in Europe Another hall will be devoted to physical anthropology

A special significance is attached to the use the department of zoology will make of the space allotted to it in the new halls, as it will place the lower orders of animals, chiefly denizens of the sea, on this lower floor, while the higher orders of animals will remain on the main floor A feature of the new halls will be one devoted to large marine mammal habitat groups such as whales, walruses, seals, sea lions, porpoises and so forth Another hall will hold systematic collections of fishes, and the third will be devoted to marine invertebrates, such as starfish, mollusks and similar creatures

Removal of these collections from the general zoological collections in the west wing of the main floor will make possible opening there a new hall of Asiatic mammal habitat groups, the nucleus of which will be the collections made by the James Simpson-Roosevelt Asiatic Expedition of the Field Museum, conducted in 1925 under the leadership of Colonel Theodore Roosevelt and Kermit Roosevelt. It is expected that about January 1, 1928, the first two groups will be installed ready for exhibition These will consist of the famous Ovis Poli sheep, named for the great explorer Marco Polo, and the

ibex, of which the Roosevelts secured a world's record head

SCIENTIFIC NOTES AND NEWS

EDWARD BRADFORD TITCHENER, Sage professor of psychology at Cornell University, died on August 3, aged sixty years Dr Titchener was born in Chichester, England, and was called to Cornell University in 1892

THE seventieth birthday, occurring on August 8, of Professor Henry Fairfield Osborn, president of the American Museum of Natural History, was celebrated on July 28 by the presentation of a Queen Anne cup made by Thomas Folkingham in 1711, and an illuminated book of resolutions containing the signatures of his colleagues and friends from all the world over These signatures were made on individual slips of vellum and included nearly a thousand names The design and decorations of the book were executed by William E Belanski The presentation took place in advance of Professor Osborn's birthday owing to the fact that he was obliged to be in the west on August 8 The committee in charge of the celebration have also invited Professor and Mrs. Osborn to be the guests of honor at a reception to be given on September 29, on which occasion the balance of the fund raised by his friends, amounting in all to nearly seven thousand dollars, will be presented to him for his research work

DR. HENRY S WASHINGTON, of the Geophysical Laboratory of the Carnegie Institution, has been nominated by the Italian government an officer of the Order of the Crown of Italy and has received from the Italian ambassador, Baron de Martino, the cross of the order in recognition of his work on the rocks and volcanoes of Italy

DR F B MUMFORD, since 1909 dean of the College of Agriculture and director of the experiment station of the University of Missouri, and his brother, Dr H W Mumford, since 1922 dean and director of the Illinois College of Agriculture, recently received the honorary degree of doctor of agriculture from the Michigan State Agricultural College, where both were graduated thirty-six years ago

THE University of South Dakota at the recent commencement exercises conferred upon Dr L S Hulburt the honorary degree of doctor of laws Dr Hulburt is professor of mathematics, emeritus, in the Johns Hopkins University Before going to the Johns Hopkins University in 1892 he was for four years professor of mathematics in the University of South Dakota

MRS ZELIA NUTTALL has been elected a fellow of the Royal Anthropological Society of Great Britain and Ireland and a corresponding member of the Geographic Society of Philadelphia to fill the vacancy created by the death of Sir John Scott Keltie

DR. R RUGGLES GATES, of the University of London, received the doctorate of laws *in absentia*, at the commencement exercises of Mount Allison University, Sackville, N. B

M LEONARDO TORRES-QUEVEDO, engineer of bridges and roads of Spain, has been elected foreign associate of the Paris Academy of Sciences to succeed the late H Kamerlingh Onnes

THE Hanbury Memorial Medal, which is given for excellence in the prosecution or promotion of original research in the chemistry or natural history of drugs, has been awarded to Dr T A Henry, director of the Wellcome Chemical Research Laboratories

M PIERRE SALET, of the Observatory of Paris, has been promoted from adjunct astronomer to astronomer, to succeed M Bigourdan, who recently retired

CARLOS G BATES, recently director of the Rocky Mountain Forest Experiment Station of the Forest Service, has been appointed director of a new section in the Forest Products Laboratory, at Madison, Wis., which will work on biological problems

DR. JOSEPH JASTROW, since 1888 professor of psychology at the University of Wisconsin, has retired and has been made emeritus professor of psychology

THOMAS A EDISON visited the Department of Agriculture in Washington on July 26 to discuss questions of rubber culture He conferred with Drs W A Taylor, chief, and Karl F Kellerman, associate chief, of the Bureau of Plant Industry. A representative of the War Department attended this conference Mr Edison was accompanied by one of his assistants He also conferred with officials of the Department of Commerce on the subject of rubber

W. L MCATEE, in charge of the division of food habits research of the Bureau of Biological Survey, recently returned from Europe, where he was from the middle of March to the middle of June on official business connected with the work of that bureau and the Bureau of Entomology He investigated methods of propagation of waterfowl and other game birds, many of them the same species that occur in the United States This work was carried on at nine establishments in France, Holland and Great Britain

DR GEORGE KEMMERER, professor of chemistry in the University of Wisconsin, and Dr W H Rich, of the United States Bureau of Fisheries, are making this summer a scientific study of the water of the lakes on Kodiak Island, Alaska Professor Kemmerer has

assisted Dr. E. A. Birge, of the University of Wisconsin and the State Geological and Natural History Survey, in the studies he is directing of plant and animal life in Wisconsin lakes, and the ability of the lakes to sustain such life.

DR CHARLES WARDELL STILES, chief of the division of zoology of the Hygienic Laboratory, Washington, D C, has been appointed delegate from the United States to the tenth International Zoological Congress, to be held in Budapest, Hungary, September 4 to 9 Dr Stiles also will attend meetings of the International Committee on Zoological Nomenclature, which will convene in Budapest on August 28, and will be in session until September 4

W C PARKINSON has left Peru to return to Washington after having completed the work he was engaged upon as consulting magnetician at the Huancayo Observatory

PROFESSOR WARREN D SMITH conducted the annual summer camp for geology of the University of Oregon in the Wallowa Mountains from June 15 to July 15, during which time he combined teaching with his personal research on some of the interesting problems of that region In August he will be engaged as consulting geologist for the Reclamation Bureau on the Owyhee Irrigation Project Dam near Adrian, Ore, and still later in the summer will be occupied with special work in Lake County in connection with a suit concerning artesian water conditions

THE topographical department of the Danish General Staff despatched a survey expedition to Greenland on May 25 of this year It is under the command of Captain F C Jorgensen, and is based on Disko Island The projected program of survey work will probably take thirty years to carry out. In addition, the expedition will supervise the construction of seismographic and wireless stations at Scoresby Sound

DR. W M. JARDINE, secretary of agriculture, gave the principal address on August 1, before the East Lansing meeting of the Country Life Conference

SIR JOHN BLAND-SUTTON will present, on behalf of the Royal College of Physicians, London, an address of congratulation to the University of Toronto at the commemoration, on October 6, of the centenary of the granting of the charter of King's College, Toronto, now the University of Toronto.

SIR JOHN MACPHERSON, professor of psychiatry in the University of Sydney, New South Wales, has been nominated for Maudsley lecturer for 1928.

WHILE returning from work in the field in the vicinity of Salem, Ky., on the geology of the Smithland Quadrangle, Dr Stuart Weller, professor of paleontologic geology for many years at the University of Chicago and assistant geologist on the Kentucky Geological Survey since 1920, died suddenly on August 5 in the automobile of a friend. Dr. Weller was fifty-seven years old.

A BRONZE plaque commemorating the life and work of Jacques Loeb, to be placed in the entrance of the auditorium, next to the tablet erected to Dr C O. Whitman, the founder of the laboratory, was unveiled at Woods Hole on August 4 Ten-minute addresses were made by Dr Frank R Lillie, president of the board of trustees and until 1926 director of the laboratory, by Dr Simon Flexner, director of the Rockefeller Institute, of which Dr Loeb was a member at the time of his death, and by Dr. Hardolph Wasteneys, of the University of Toronto, who was one of Dr Loeb's students

THE Society of Sciences, Letters and Arts of l'Aveyron has erected a monument in memory of the botanist, Hippolyte Coste

Popular Astronomy, quoting from *Ciel et Terre*, reports that on the occasion of the distribution of prizes to the students in the Seminary and College of St. Catherine, where Donati received his education up to the time of his entrance to the university, the life of this noted astronomer was commemorated. The authorities of the city, Cardinal Maffi and a number of distinguished citizens assisted in the ceremonies On December 16, through the aid of a committee of citizens of Pisa, a bronze tablet was placed on the house where Donati was born, and on the same day the one hundredth anniversary of his birth was celebrated On this occasion Professor Marco Salvadori, of the College of St Catherine, reviewed his life

EDWARD S HARKNESS has given the sum of $250,000 to Memorial Hospital, New York City, for the purchase of four grams of radium, doubling the supply now possessed by the hospital.

AN International Congress of Neurologists and Alienists opened on July 26, under the patronage of President Doumergue, at the Château of Blois, Paris, Professor Raviart, of Lille, presiding The congress, which will last for five days, is being attended by four hundred delegates from seventeen countries

THE combined meeting of the Section of Neurology of the Royal Society of Medicine and the American Neurological Association was opened on July 25 by a reception at the Royal Society of Medicine, guests were received by Sir James Berry, president of the society, and Lady Berry. Sir James Purves-Stewart, president of the section, gave an address on "Mount

Athos, a Survival of the Middle Ages" The Hughlings Jackson lecture was delivered by Dr Charles L Dana During the afternoon demonstrations on pathological subjects were given, followed by a dinner in the evening

A TOUR of delegates to the third World's Poultry Congress has been arranged so that European and other delegates may visit some of the more important educational marketing and poultry raising sections of the eastern United States The party left Ottawa on August 4 and after visiting a few places in Canada proceeded to Cornell University, Ithaca, N Y Later the poultry and egg markets of New York City will be visited and the delegates will proceed through New Jersey to inspect the more important poultry raising sections of that state Finally a visit will be made to the United States Department of Agriculture, where the visitors will be made acquainted with the work carried on by the Bureau of Animal Industry and the Bureau of Agricultural Economics

THE International Conference on Flour and Bread Manufacture, postponed last year on account of technical difficulties, will definitely take place in Prague, Czechoslovakia, in September, 1927, under the auspices of the Czechoslovakian government The exact date and full details of the program are yet to be determined The preparatory committee has the following officers *Chairman,* Jan Jolinek, *Editor,* Francis Hruska, *Secretary,* Karel Krtinsky

A STATE clearing house of information on problems of delinquency and juvenile criminology was planned at a recent meeting of ten leading Wisconsin social workers sponsored by the Wisconsin Conference of Social Work A plan for holding child guidance clinics in some 30 Wisconsin communities was also approved Professor Kimball Young and Professor Robert West, of the University of Wisconsin, and Dr R E Bushong, director of the Milwaukee County Mental Hygiene Clinic, were appointed to map out the work to be done by these clinics

THE first National Fuels Meeting sponsored by the American Society of Mechanical Engineers will be held at St Louis, from October 11 to 13

Industrial and Engineering Chemistry reports that at the annual dinner of the American Welding Society held in New York City recently, President F M Farmer announced the donation of an award, the gift of Samuel Wylie Miller, to be presented by the society annually in appreciation of work of outstanding merit in advancing the art and science of welding The award is a gold medal, which will be known as the Miller Medal.

R H FINCH, of the Lassen Volcanic Observatory, informs us that a museum to make better known the natural history of Lassen National Park was opened with a formal dedication ceremony on July 4. It is situated on the shore of Manzanita Lake near the northwestern entrance of the park The museum was erected by Mr and Mrs B F Loomis as a memorial to their daughter Mae and they plan to turn it over to the National Park Service as soon as the boundary of the Lassen National Park is extended to include the area in which the museum is located A pictorial history of the recent activity of Lassen Peak is the most striking part of the exhibit, though the wild life and the different kinds of lavas in the park are well displayed.

WE learn from the *Journal* of the American Medical Association that for two years about fifty members of the faculty of the University of California and assistants have been investigating the cause of pyorrhea The Carnegie Corporation and various dental societies furnished about $100,000 to carry on this work Some of the experiments seem to show that in animals and man a condition approximating pyorrhea can be induced by "slight upsets in the acid-base balance of their diet" On account of this seeming "tangential direction" which the research took, the stomatologic research committee of the university requested the Carnegie Corporation to send the following men to California for consultation on this problem Dr Lafayette P Mendel, Sterling professor of physiologic chemistry, Yale University, Dr Elmer V McCollum, professor of biochemistry, the Johns Hopkins University School of Hygiene and Public Health, and Dr Edward H Hatton, professor of pathology and special research investigator, Northwestern University Medical School, Chicago Dr Mendel first made the trip, and Dr McCollum went late in July Dr Hatton was expected to arrive early in August. Heretofore, research into the cause of pyorrhea has been largely through the approach of bacteriology rather than of nutrition

THE departments of the University of Georgia Medical Department, Augusta, that were affected by the recent school fire are being renovated; the roof, the only part that burned, is being restored. The damage was estimated at $16,000 Space in the south wing, heretofore unused, is being converted into quarters for the department of experimental surgery with a large operating room, three rooms for research and an office The space formerly used by the surgical department on the first floor will be taken over by the department of public health. The medical department is appealing to the legislature now in session for an increased appropriation of $20,000 a year for maintenance to replace a similar amount that

has been received for the last five years from the Carnegie and Rockefeller foundations, which contract has expired The public-spirited citizens of the community and "official Augusta" contributed a similar amount to that given by the foundations, and these funds were used chiefly to inaugurate full-time departments in medicine, surgery and obstetrics

UNIVERSITY AND EDUCATIONAL NOTES

A gift to the Yale library of $100,000 in memory of Albert DeSilver, '10, has been announced The fund has been given to carry out the wish which Mrs John Bradley Lord, of Greenwich, Conn, expressed shortly before her death in February, 1926, that a fund be established at Yale in memory of her son, Albert DeSilver The income is to be used for the purchase and care of books and periodicals in the field of chemistry

An anonymous gift of £10,000 has been received by the University of Wales for the encouragement of research.

Dr A. Warren Stearns has been appointed dean of the medical school of Tufts College He succeeds Dr Stephen Rushmore, who has resigned to enter private practice.

Dr Paul Whitely, of the University of Chicago, has been appointed associate professor of psychology at Colgate University Dr Donald A Laird, director of the laboratory of psychology, has been promoted to be professor of psychology and chairman of the department

Dr Earle B Miller, of the University of Wisconsin, has been appointed professor of mathematics and physics at Illinois College, Jacksonville.

Dr. E H Kettle, professor of pathology and bacteriology in the Welsh National School of Medicine, has accepted a professorship of pathology in the University of London Dr. Bronislaw Malinowski, reader in the university, has been appointed to the university chair of anthropology, and Dr. W H Linnell has been appointed to a readership in pharmaceutical chemistry.

DISCUSSION AND CORRESPONDENCE

A NEW AGRICULTURAL PROFESSION

About twenty years ago the consulting agriculturist giving advice to farm owners for a consideration was almost unknown in the United States, although at that time Mr George T. Powell, the well-known fruit grower, was one of the first pioneers in this profession. Then came various other "agricultural experts," "farm advisers," "consulting agriculturists" and "farm doctors," as they styled themselves—all more or less (principally less) competent—and most of them not staying in business very long Soon after began the development of extension work and the county agricultural agent system paid for by federal, state and local funds This system not only has been of great service to American agriculture but has had the effect of stimulating the farmer's desire for more information and advice especially adapted to his own particular farm conditions

Overwhelmed as extension workers and county agents have been with constantly increasing demands for special service, it has been well-nigh impossible for them to devote any large proportion of their time to any one individual or company without offending other farm owners who felt that they were entitled to an equal amount of service Yet it is evident that, if a farmer needs technical assistance, he must not only be given preliminary plans but also be assisted to work them out to a successful conclusion in full detail Only one who has actually done it realizes the amount of time and work entailed in preparing a complete farm operating plan, including rotations, seed, fertilizer and spraying schedules, production and cost estimates and an operating budget But when it comes to taking over the management of one or more farms only the professional agricultural consultant is free to devote himself to such work.

In following the development of the profession of consulting agricultural engineer, it is interesting to note the trend of state and federal agricultural agencies toward "service at cost" Thus county agent work itself has been partially supported by fees paid by the farmers themselves Extension specialists making special inspections for farmers now have their traveling expenses paid by those whom they serve An increasing number of agricultural bulletins is being sold instead of distributed free Cow-testing associations formed by the agricultural colleges employ their own testers And more recently in Illinois a group of farmers organized by the Agricultural College has hired its own salaried farm cost accountant to keep its members' books So it is natural that the federal and state extension divisions should see in the consulting agricultural engineer a means of augmenting their own efforts with a saving of their time and appropriations Where calls for special service are received some of these government agencies are now referring such inquiries to competent agricultural consultants. And as the demand for such professional services increases, it is believed that the agricultural colleges will help to meet it by offering special courses to train men for the profession of consulting agricultural engineer

That this profession has at last received official recognition is evidenced by the recent action of the council of the American Society of Agricultural Engineers. Authority has been granted for the formation of a division of consulting agricultural engineers, with membership requirements for the admission of men of high professional standing and a code of ethics. This group of consulting agricultural engineers proposes to cooperate with federal and state agricultural agencies and its members are devoting themselves particularly to commercial agriculture

STANLEY F. MORSE

NEW YORK, N. Y

A PROBABLE ORIGIN OF PETROLEUM

THE article in your issue of July 1 in regard to tests being made by Dr Parker D Trask on sea-bottom muds for the presence of oils is of interest to me, as I have for many years believed that oil shales and mineral oils were the result of deposition formed, not on the sea-bottoms, but on the bottoms and shallows of brine lakes My reasons for this belief are as follows

Oil fields are quite frequently found contiguous to salt deposits, and the water which succeeds the oil in most wells is salt water

In some brine lakes, such as Great Salt Lake, Utah, there is a great deal of marine life, but of very small size In Great Salt Lake there is an abundance of very small shrimp or crayfish, and in certain of the marshes on the lake shores these small creatures seem to die in large numbers, so much so that the marshes in places give off an almost unbearable odor, much similar to the smell of drying cod fish

The natural presumption is that the bodies of these small creatures do not decompose in the ordinary way but become pickled in the brine and are more or less permanently preserved

Where conditions have been favorable and a mud bed formed, having the preserved remains of this small marine life imbedded in them, this mud might very readily have been changed into beds of shale carrying a large percentage of oil Petroleum may possibly be a distillation from such shale, and being fluid may have moved about over a considerable area

Mud banks would normally form at the mouths of rivers flowing into the brine lakes and the rivers would be continuously carrying into the lakes large quantities of organic matter, which would be acted on by the brine and deposited with the mud

Some forms of vegetable life seem to grow freely in water containing a very high percentage of salt Such vegetable matter probably would not decompose in the ordinary way. It seems quite possible that the difference in the composition of mineral oils from different locations may be due to the different proportions of animal to vegetable matter in the original deposition.

I have not the slightest doubt but that if Dr. Trask will test some of the muds near Salt Lake City he will find them to be rich in oil These marshes are of considerable extent in places, and the mud might prove to be a source of oil of some commercial importance.

While brine lakes are not very numerous at the present time, in earlier geological periods they seem to have been quite numerous, and in some cases of vast extent, as is clearly indicated by the very extensive salt deposits to be found in many parts of the world.

JOHN ROGER

QUOTATIONS

THE SURVIVAL OF THE FITTEST

IN the struggle for existence that life represents, the survival of the fittest appeals to many thinkers as the outstanding ideal They argue that it makes for strength and progress in the race if the unfit—the weaklings and the degenerates—are eliminated through their inability to meet the strenuous conditions of rigorous living Consequently not a few persons challenge many features of the modern program for public health and preventive medicine as well as allied social schemes for human comfort on the ground that these tend to counteract and discount the advantages that selection through inherent fitness is alleged to represent As a recent writer has expressed it, by protecting us from our enemies, the bacteria and the viruses, by removing the sources of disease, by showing us how to avoid unfavorable conditions and to find favorable ones, in short, by bringing us and our environment into harmony, the "civilizers" are promoting the survival of the unfit, they are progressively filling the human race with the weak and the degenerate, who must hand on their weakness and degeneracy to their descendants

Such arguments can not be lightly dismissed. The modern investigations in genetics have, indeed, shown that it is quite possible to produce a population composed of the congenitally defective—"the halt, the blind, the weak, the variously deformed and degenerate" The biologist of to-day refers these possibilities back to the transmission of defective "genes," the hereditary substance carriers that determine development In a stimulating address before the National Tuberculosis Association at Indianapolis in May, Professor Jennings,[1] of the Johns Hopkins University,

[1] Jennings, H S "Public Health Progress and Race Progress Are They Incompatible?" SCIENCE 66: 45 (July 15) 1927.

sustained the thesis that defects in genes become as open to remedy as defects in nutrition. After all, the underlying problem is largely one of chemistry The genes are chemical compounds The consequences of a defective thyroid secretion are remedied by introducing synthetically produced thyroxin with the food In principle it is clear, says Jennings, that defects in the store of chemicals given us by heredity may be supplied by other means, that undesirable things in the store of genes may be cancelled or corrected, that reactions among them which take an undesirable turn may be altered, set right All these things, he adds, are seen to be mere matters of technic one needs but to know how

Of course, the correction of defects attributable to hereditary weaknesses does not necessarily abolish the latter However thoroughly the natural effects of his "poor constitution" may be offset and his own life made more satisfactory alike to himself and to society, the defective individual continues to be a potential producer of the unfit. Shall he therefore be prevented from surviving? Not infrequently physical shortcomings go hand in hand with conspicuous mental capacities The artist is by no means always an athlete Shall the progress of the race be safeguarded by preventing the application of scientific ingenuity whereby the hereditarily weak may secure the enjoyment of a full, useful, happy, long life? To such queries Jennings has offered a cogent reply. The mere survival of a genetically defective individual does nothing to increase the degeneracy of later generations—provided he does not propagate Not survival alone, but also propagation, Jennings rightly adds, is required for the perpetuation of defective genes Without propagation, survival is harmless, so far as race deterioration is concerned

The implications of these statements are fairly obvious In their relation to the modern activities in the field of public health and social betterment they place burdens of responsibility where they have been only lightly considered heretofore The public health worker, Jennings remarks, must become genetically minded, eugenically minded. If by his activities he promotes, in the congenitally defective, propagation as well as survival, his work does indeed tend toward a measure of racial degeneration. The control of the instincts that lead to propagation is a formidable problem The subject is one that can not be thrust aside merely because it calls for considerable delicacy in presentation and, as yet, undevised tact in its furtherance. In any event the control of our environments will not be summarily abandoned We still know too little about the details of heredity to assume that protective and defensive actions or selective control of the environment are inevitably threatening to human welfare in the long run We may properly watch for defective genes and stop the propagation of their bearers, but, as Jennings concludes, the proposal to abandon control of the environment—the cessation of the process of adjusting ourselves to the conditions —is not a serious contribution to the practice of life. —*The Journal of the American Medical Association*

SCIENTIFIC BOOKS

Catalogue of the Birds of the Americas and the Adjacent Islands in Field Museum of Natural History Part V Tyrannidae By CHARLES E HELLMAYR Field Museum, Chicago, April 11, 1927. Pp 517.

THE admirable synonymic and bibliographic catalogue of birds of the Western Hemisphere should be known to all zoologists Begun years ago by Charles B Cory, and continued after his death by C E Hellmayr, it stands as a model worthy of imitation by others than ornithologists What a splendid thing it would be if in the course of time the whole fauna and flora of the Americas could be catalogued in this fashion! It is of course true that in many groups the genera and species are still so imperfectly known that no reasonably complete presentation of the fauna is possible Yet there are other organisms than birds which could very well be listed in such a manner as to illustrate principles of geographical distribution, and give us a fairly adequate idea of the leading facts Such, for instance, are the butterflies Looking through the bird volumes, noticing the distribution of the species and subspecies, one is continually reminded of parallel facts in relation to the butterflies. If these latter could be listed in a similar fashion, and the two series compared, it is certain that interesting biological generalizations would emerge. A list of the terrestrial molluscs would be no less instructive The method of the catalogue is to give the full synonymy and bibliography of each genus, species and subspecies, citing type localities, and giving the range as exactly as possible In footnotes are added many critical comments, including brief diagnoses of subspecies, and often of genera

To the general naturalist, special interest attaches to those birds which are peculiar to islands off the American coast Several such are included among the Tyrannidae The genus *Nesotriccus* (*N ridgwayi* Townsend) is confined to the small Cocos Island, off the Gulf of Panama It is however related to *Eribates* (*E magnirostris* Gould), a genus only found in the Galapagos Islands The scarlet or vermilion flycatchers (*Pyrocephalus*), well known on the mainland, are represented by two subspecies

in the Galapagos group, or five according to the former finer division of Ridgway (1894) One is peculiar to Chatham Island, while the other exists on nine islands The isolated Juan Fernandez has a peculiar species (*Spizitornis fernandezianus* Philippi) of a continental genus The Falkland Islands possess a *Muscisaxicola* (*M macloviana* Garnot) which is only subspecifically distinct from the mainland representative, and the same sort of thing occurs in the Island of Fernando Noronha, off Brazil, the *Elaenia* (*E. ridleyana* Sharpe) obtained there being only a large insular race of a continental species. The genus *Elaenia* is rich in peculiar insular types in the West Indies, and has one on the Tres Marias Islands, off Mexico *Myiarchus* is similarly rich in West Indian endemics, while the genus *Tolmarchus* is confined to the West Indies, with special forms in the Bahamas, Cuba, Cayman Islands, Jamaica, Porto Rico and Haiti The monotypic genus *Hylonax* (*H validus* Cabanis) is restricted to Jamaica

T D A COCKERELL

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE DEVICE USEFUL FOR DRAWING SYMMETRICAL OBJECTS

THE method commonly employed in drawing a bilaterally symmetrical object such as an insect is to make a drawing of one half of the object, either freehand or by use of a camera lucida, trace this on semi-transparent paper, and then retrace from the latter to outline the other half of the drawing For several years I have used the device described below and have found it much more satisfactory than the tracing-paper method Inquiry among entomologists, to whom it should be especially useful, has yet revealed no one familiar with it

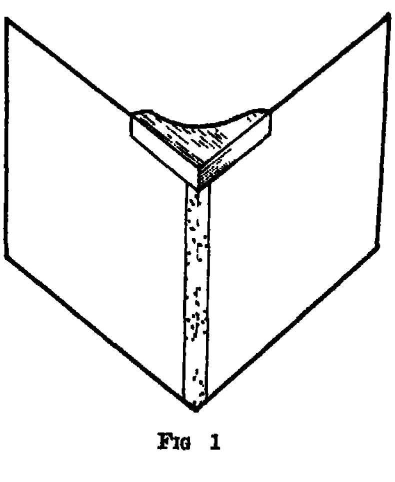


FIG 1

The device consists essentially of two rectangular pieces of glass A convenient form may be made by removing the emulsion from two 5" x 7" photographic plates and fastening these together in planes at right angles They can be held rigidly in position by placing a narrow strip of adhesive plaster or binding tape along the angle where the edges meet and gluing across the upper corner a portion of the lid of a small pasteboard box, as shown in the accompanying figure

Draw one half of the object and make a straight line constituting the median line of the final drawing Then place one section of the glass upon this line, look diagonally through the glass from above the part drawn and outline the image on the opposite side

RALPH H SMITH

CITRUS EXPERIMENT STATION,
UNIVERSITY OF CALIFORNIA,
RIVERSIDE, CALIF

AN AIR-TIGHT STOPPER FOR BOTTLES CONTAINING VOLATILE LIQUIDS OR FOR LARGE MARIOTTE APPARATUS

THE difficulties involved in securing air-tight seals with rubber stoppers are a matter of common experience to those working in the laboratory This is particularly true where large Mariotte apparatus are employed or where volatile liquids are enclosed in bottles from which corks may be easily blown out An expansible stopper is shown in the illustration which overcomes some of the uncertainties frequently accompanying the use of an ordinary stopper The stopper was improvised for use on a metal Mariotte apparatus supplying a shallow evaporation tank It was found to be so well adapted to the purpose that it has seemed desirable that some note should be made of it

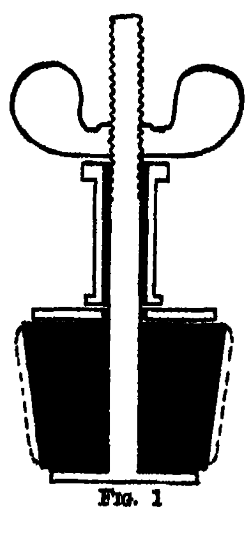


FIG. 1

As shown in the illustration the stem of a bolt with a large flat head is passed through a one-hole rubber stopper A substantial washer is then placed over the stem of the bolt and above this a cylindrical metal sleeve which serves to carry the wing nut away from the mouth of the bottle affording greater freedom in tightening down on the rubber stopper After such a stopper has been pushed into place, a few turns of the nut compress the rubber longitudinally and bring about a lateral expansion which holds the stopper in place and gives a sufficiently tight seal for any ordinary purpose.

FRANK M EATON

BUREAU OF PLANT INDUSTRY

THE FINDING OF PLEISTOCENE MATERIAL IN AN ASPHALT PIT AT CARPINTERIA, CALIFORNIA

IN February, 1927, on the Lucien Higgins ranch in Carpinteria in southern Santa Barbara County, California, a steam-shovel which was taking out road material over a deposit of asphalt disclosed some bones These were brought to the attention of Mr Norton Stuart, curator of the Santa Barbara Museum of Natural History Mr Stuart at once began an investigation of the field and after several unsuccessful attempts to locate the source of the earlier finds, at last discovered a mass of material which extends to a depth that has not yet been measured Here Mr Stuart found a great number of bones of birds, mammals and rodents, together with pine cones, leaves and other plant material

Mr Stuart was able to identify some of the bones as those of *Teratornis*, others as those of a horse, close to *Equus occidentalis,* and the cones as those of the Monterey Pine, *Pinus radiata.*

The Santa Barbara Museum of Natural History then invited Mr Chester Stock and Mr Ralph Chaney to examine the material which had been discovered, and has arranged with the Carnegie Institution to continue the excavation and the study of the material disclosed.

The discovery of this interesting material exemplifies the value of a local natural history museum on whose staff are men who can grasp the significance of such local discoveries

RALPH HOFFMANN,
Director

SANTA BARBARA MUSEUM
OF NATURAL HISTORY

PLEISTOCENE FAUNA AND FLORA

ALTHOUGH bituminous deposits along the coast of southern California, between Santa Barbara and Ventura, have been known for a number of years, the early mining operations for asphalt in this region apparently never brought to light the presence of fossil remains in these accumulations Recently the discovery of vertebrate and plant materials of Pleistocene age in an asphalt bed south and east of Carpinteria, made as a result of excavations for road materials, has directed the attention of the Santa Barbara Museum of Natural History to this locality.

The deposit in which the fossil organisms are found has been described and referred to by several authors It was considered in some detail by Eldridge[1] in his extensive report on the asphalt and bituminous rock deposits of the United States. In 1907 Arnold[2] showed the extent of this deposit on the geological map of the Summerland Oil District, Santa Barbara County, California, and discussed its occurrence in the report on the geology and oil resources of the Summerland region

Through the kindness and cordiality of Mr Ralph Hoffmann, director of the Santa Barbara Museum and Mr Norton Stuart, curator, the Carnegie Institution of Washington and the California Institute of Technology have been invited to explore the locality and to cooperate with the Santa Barbara Museum

The geological section is well exposed in the sea-cliff one half to three quarters of a mile southeast of Carpinteria and is essentially that described by Eldridge The Pleistocene deposits containing the vertebrates and plants lie unconformably above highly inclined Tertiary (Miocene) shales and sandstones, resting upon a surface apparently developed as a result of marine planation of the older rocks The Pleistocene formation is practically in horizontal position and reaches a thickness in cliff-section of 10 to 12 feet It consists of sharp sand and some gravel and has been thoroughly impregnated by petroleum The sand is sometimes cross-bedded Eldridge records the finding of an occasional shell in this stratum

Overlying the bituminous sand and gravel is a white or brownish sand which is at least two and one half feet thick and may be somewhat thicker. This sand has not been penetrated extensively by petroleum and, as compared with the underlying formation, may be regarded as practically free of such penetration. That the unimpregnated sand accumulated after a second period of erosion during which a part of the bituminous sand was removed and the bed containing the remains of land organisms

[1] Eldridge, G H, 22nd Ann Rpt U S Geol Surv, Pt I, pp 444–445, pl 58, 1901

[2] Arnold, Ralph, U. S Geol Surv Bull, pp 33–35, pls. 1 and 3, 1907.

was truncated is suggested by the relationships of the two deposits.

Above the white or brownish sand is a dark earthy material reaching a thickness of at least six feet. In the vicinity of the fossil occurrence the soil layer contains many marine shells and shell fragments and these are strewn also over the surface of the ground. Indian remains and implements have been found in the soil stratum, pointing quite unmistakably to the fact that the locality has been occupied in recent time as an Indian site.

The Pleistocene mammals, birds and plants found in the bituminous layer appear to be concentrated in a relatively small area, but further exploration may reveal a more extensive accumulation of remains. The occurrence is unique in that it has furnished a large representation of plant remains. The plant assemblage is discussed below by Dr. Ralph W. Chaney and Mr. Herbert L. Mason, and the birds by Dr. Loye Miller.

The mammals occurring at the Carpinteria locality include the following forms:

Aenocyon, near dirus Leidy
Canis, probably ochropus Esch.
Urocyon, near californicus Mearns
Mephitis, sp.
Odocoileus, sp.
Equus, near occidentalis Leidy
Lepus, sp.
Eutamias, sp.

The mammals include types found also at Rancho La Brea and at McKittrick. The single exception is the chipmunk which is not recorded at the Los Angeles locality and thus far has not been recognized at McKittrick. The assemblage contains certain elements suggestive of a forest environment, thus presenting the possibility of ecologic conditions which differ somewhat from those prevailing at Rancho La Brea and at McKittrick during the period of their accumulation. The time relationship of the Carpinteria fauna to those from the asphalt stations mentioned above may be more definitely stated when further collections are obtained.

An important feature of the occurrence is the apparent clearness with which the relationship of time of accumulation of the animal and plant remains to the geological record of this region can be established.

CHESTER STOCK
CALIFORNIA INSTITUTE OF TECHNOLOGY,
PASADENA, CALIF.

BIRD REMAINS

THE bird remains examined total eighty determinable specimens which are distributed on preliminary examination among fifteen species, all of which have been reported from Rancho La Brea and all but two of which are common to Rancho La Brea, McKittrick, and the new horizon under discussion.

Four of the species are extinct, namely *Teratornis*, *Parapavo*, *Neophrontops*, and *Neogyps*. A fifth species, *Polyborus*, is foreign to the region in Recent time. *Parapavo* and *Gymnogyps* do not occur at McKittrick. Thus the fauna shows closer affinity with Rancho La Brea than with McKittrick, suggesting that the San Diegan region was distinguishable from the San Joaquin Valley Region by faunal differences as it is to-day. Such a form as *Parapavo* might naturally be expected to conform to the physiographic barrier of the Liebre and the Tejon Mts. even though less elevated than at present. That the strong flying *Gymnogyps* should have been so restricted is difficult to believe.

List of species and specimens of birds. The asterisk (*) indicates a species extinct in the region to-day.

	Specimens
Anas platyrhynchos (?)	2
**Parapavo californica*	17
Lophortyx californica	1
Gymnogyps californianus	4
**Teratornis merriami*	1
Aquila chrysaetos	28
Buteonid hawks	15
**Neogyps errans*	1
**Neophrontops americanus*	1
**Polyborus cheriway*	2
Bubo virginianus	2
Colaptes cafer	2
Geococcyx californianus	1
Corvus corax	2
Small passerine species	1
	80

The single species of swimmer and the total absence thus far of waders coupled with the occurrence of such species as the road runner and the California peacock would indicate a coastal plain quite independent of strand influence.

LOYE MILLER
UNIVERSITY OF CALIFORNIA,
LOS ANGELES, CALIF.

FOSSIL PLANTS

ANY facts that bear upon the subject of the origin and distribution of endemic floras are particularly welcome. This field of science has at its command very little in the way of evidence that is concrete or convincing. Therefore the finding in the geological record of fossil materials that prove the existence of a flora in past time in a locality remote from its

present distribution is most significant. Such is the recently discovered flora of the Pleistocene Brea deposits at Carpinteria, Santa Barbara County, California.

This flora as now known represents a forest assemblage dominated by coniferous trees with a heavy undergrowth of shrubs and herbs Following is a list of fossil plants thus far found in the deposit

Pinus radiata Don
Pinus muricata D Don
Cupressus goveniana Gord
Arceuthobium, sp
Chorizanthe, sp
Platanus, sp
Amelanchier, sp
Arctostaphylos, 3 species
Numerous other small elements not yet identified

Two hundred miles northward there exists to-day a relict flora limited to the coastal slopes in the vicinity of Monterey Bay Small groves occur northward and southward over a total distance of about fifty miles This forest flora is dominated by the Monterey Pine (*Pinus radiata* Don) and has associated with it the Bishop Pine (*Pinus muricata* Don), the Monterey Cypress (*Cupressus macrocarpa*), and the Gowen Cypress (*G goveniana* Gord.) The ground cover of this forest is composed largely of shrubs of Manzanita (*Arctostaphylos*) and California lilac (*Ceanothus*), there being several species of each Aside from these there are many other less common shrubs and a host of herbaceous plants. It is this forest flora that existed in Pleistocene time in the vicinity of Carpinteria, practically as it exists to-day on the slopes back of Monterey Bay

The preservation of the fossil material is particularly fine and the completeness of the specimens is unique The conifers are all represented by wood, leaves, ovulate and staminate strobile, the mistletoe is represented by twigs, scale-leaves, staminate and pistillate flowers, and fruits, the Manzanitas by wood, leaves, flowers and fruits Particularly noteworthy are the flowers of Amelanchier and of the Manzanitas, in which minutest details as to pubescence, surface markings and stamen peculiarities are plainly discernible. Epidermal layers of leaves show remarkable structure of tissue and stomata Sections of much of the wood show mycelial threads of parasitic fungi as well as the borings and remains of beetles The threads of fungi, preserved and stained by petroleum, stand out in striking contrast to the tissues of the wood.

The absence of Ceanothus in the fossil deposits is noteworthy, as it occupies such an important position in the living forest. However, further excavation is expected to bring to light other species and it is reasonable to suppose that Ceanothus may be among them

In comparing the flora with that of the other tar deposits of California it is significant to note that there is but one species in common with each of them. *Pinus muricata* is found also at Rancho La Brea and one species of Arctostaphylos occurs in the McKittrick deposit The La Brea flora contains a Cypress specifically distinct from that at Carpinteria It is associated with elements indicating a drier habitat such as *Juniperus* sp , *Quercus agrifolia* Nee, *Celtis* sp and other elements of a similar nature The La Brea flora appears to be ecologically comparable to the openly wooded hills of the inner California Coast Ranges, whereas the Carpinteria flora is obviously coastal The McKittrick flora has not yet been studied but in all probability is of the inland type

From the fact that all the fossil plants from Carpinteria are identical or similar to species now living in California it seems proper to refer this flora to the Pleistocene The assemblage indicates a climatic change in the region since Pleistocene time involving a lessening of the rainfall, an increase in the evaporation rate, and a considerable lessening of the amount of summer fog

Ralph W Chaney
Carnegie Institution of Washington
Herbert L Mason
University of California

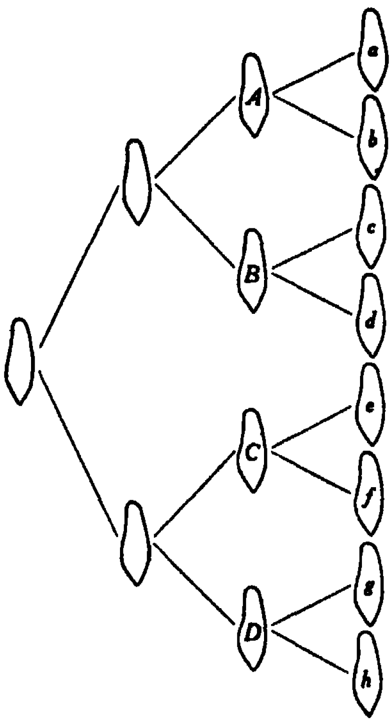
SPECIAL ARTICLES

THE AXIAL GRADIENT IN PARAMECIUM

In work on the effect of crowding in *Paramecium caudatum* it was noticed that individuals from the same parent, under identical conditions, divided at different rates Further, it was found that in the isolated fission products of animals which had divided in the morning the anterior piece had a more rapid rate, but in those isolated in the evening after division, the posterior piece divided first This suggested a temperature effect To test this the exact time of division of fission products was recorded for three filial generations at three temperature ranges, in fifteen cases at 26 to 30 degrees, in fourteen cases at 18 to 22 degrees, and in twelve cases at 13 to 17 degrees Centigrade. The experimental animals were transferred from room temperature, 18 to 22 degrees, to the high or low temperature for the period of the experiment. Constant attention was required in the experiments, for approximately forty-eight hours at highest temperature and over seventy-two hours at

low temperature, in the effort to obtain the exact time of division of all the progeny and to identify the fission products at the time of division and to reisolate them to the fourth generation.

In the division of the first filial generation at 26 to 30 degrees, the anterior cell always divided before the posterior, at 13 to 17 degrees, the posterior piece always divided first, and at 18 to 22 degrees the relative rate varied The following table gives the distribution of cells having the highest and lowest rates at the high and low temperatures (see diagram)



Temperature	Piece	26–30° per cent	Piece	13–17° per cent
	a	79 9	h	91 6
Highest rate	e	13 3	d	8 3
	c	6 7		
	h	93 3	c	41 6
Lowest rate	f	6 7	a	33 3
			e	16 7
			g	8 3

In the third generation at high temperatures, the "a" piece had the most rapid rate in 79 9 per cent of the cases and in the other 20 1 per cent it came second, while the "e" piece, which is the anterior piece of the posterior cell produced in the second generation, had the highest rate in 13 3 per cent of the cases The "h" piece under these conditions had the lowest rate in 93 3 per cent. and the "f" piece in 6 7 per cent. of the cases

At the low temperature range, 13 to 17 degrees, there is a marked reversal. The "h" piece divided most rapidly in 91.6 per cent. of the cases and in all other cases the "d" cell had the most rapid division rate, but there was considerable variation with respect to which pieces showed the lowest rate, "a" pieces were lowest in 33 3 per cent., "c", in 41 6 per cent., "e", in 16 7 per cent, and "g", in 8 33 per cent. Here there is indicated a possibility of acclimatization or recovery in the anterior pieces, since in the preceding division the "A" piece had the lowest rate in 74 9 per cent., and the "C" piece in 25 1 per cent

At the intermediate temperature range, 18 to 22 degrees, there was no noticeable order of division

These results suggest an interpretation in terms of Child's gradient theory The axial gradient in Paramecium has been indicated by various methods, but the evidence from cell lineage presented here is of particular significance since there is less uniformity in cytolysis along the axis of Paramecium than with any other ciliate thus far examined [1] It has been shown for some forms, *e g*, Planaria, that a rise in temperature up to a certain point accelerates the more active levels to a greater degree than the less active In view of these facts it may be suggested that the sudden rise of temperature accelerates, and the lowering of temperature retards physiological activity to a greater extent in the anterior than in the posterior region of the body Some of the data suggest that if the cultures were kept at the different temperatures for a longer time, acclimatization would obliterate the differences in division rate.

At the intermediate temperature the anterior end is neither inhibited nor accelerated sufficiently to show either a more or less rapid rate of division consistently Apparently there may be an inheritance of the relative regional metabolic rates of the original animal in the fission products at least to the third filial generation

The differential rate of division of progeny of a single individual may account for some of the difficulties involved in obtaining consistent results in experimental work on Paramecium [2]

WALBURGA PETERSEN
WHITMAN LABORATORY
OF EXPERIMENTAL ZOOLOGY,
UNIVERSITY OF CHICAGO

[1] Child, C. M., and Deviney, Ezda, 1926. "Contributions to the Physiology of Paramecium caudatum." *Jour. Exp Zool*, Vol. 43, p. 257.

[2] I am indebted to Professor W. C. Allee, of the Department of Zoology, and to Dr. Marie A. Hinrichs, of the Department of Physiology, for suggestions during the progress of this work.

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CONTENTS

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JOSIAH WILLARD GIBBS AND THE EXTENSION OF THE PRINCIPLES OF THERMODYNAMICS

FIFTY years ago there was being published in the *Transactions* of the Connecticut Academy of Sciences a paper by Josiah Willard Gibbs, then professor of mathematical physics at Yale. This paper bore the title, "On the Equilibrium of Heterogeneous Substances." To-day from various parts of the world come notices and reports of meeting of societies and groups of scientific men engaged in apparently most diverse lines of investigation or industry, who, recognizing the lapse of fifty years and the changes they have brought, pause to recall the event of the publication of Gibbs's paper and to pay superlative tribute to the intellect and accomplishment of a man who influenced so profoundly the remarkable scientific progress made during this period.

It is therefore appropriate to call attention at this time to some of these memorial tributes and in particular to some of those expressed at the recent jubilee celebration held in his honor by the Chemical Society of Holland, for by quotations from them it may be realized through the words of eminent scientists the high esteem in which the most eminent American man of science is held throughout the world. By this means, too, something may be conveyed of his character, his industry, his wonderful ability for taking pains, and chiefest, his commendable lack of self interest in research.

It is worth while also to refer to the environment of Gibbs, since the environment of a man—especially the intellectual environment of an intellectual man—is an essential part of him and may largely determine the form and direction his intellectual activities shall take.

The period covered by the life of Gibbs, 1839–1903, was marked by an unusual interest and activity in physics. It is only necessary to recall the names of eminent physicists of that period to be assured of this. This interest, too, was general, and in so far as it pertained to the people at large, was inspired by the relation, then becoming more and more obvious, between the useful and practical applications of physics to industry and commerce. Industry was beginning to establish its laboratories and seek the leadership of scientific method.

The concept of energy was emerging during the early life of Gibbs and although not yet seen with

enough precision to require a name and definition attempts had nevertheless already been made to define the possibilities of machines In 1847 appeared the paper of von Helmholtz, "Die Erhaltung der Kraft," which needed only the substitution of the word *Energie* for that of *Kraft* to reveal in a most extended sense the principle of the conservation of energy that found so rational a place beside the principle of the conservation of mass that had earlier found expression

The situation in physics during the formative years of Gibbs was not greatly unlike that that surrounds a young student at the present day The attention is intensely directed to a new vision just ahead and its alluring possibilities In the early years of Gibbs it was the concept of energy and the dynamical theory of heat, out of which ultimately grew the formulation of the first and second laws of thermodynamics and, in these still later days, the Theorem of Nernst. In the present day the vision is also alluring for it always pushes forward. It now seeks, though not an ultimate, yet a still more inclusive generalization through a better knowledge of the structure and mechanism of the atom. There is now scarcely any phase of physics uninfluenced by this new development—just as in Gibbs's youth the major interest was in statistical mechanics and thermodynamics

Gibbs followed the trend of his time He sought the inspiration and instruction of the pioneers who were establishing the laws and principles of the then new development in physics The years 1867 to 1870 he spent as a student in Europe, studying there physics and mathematics, and, among other sources receiving inspiration from Magnus, Helmholtz, Kirchhoff and Clausius These names are inseparably connected with the development of the principles of thermodynamics

After his return from Europe, Gibbs was elected to the professorship of mathematical physics at Yale, 1871 The direction of his activities had now been determined even to subject and method All his subsequent effort was to be directed to the mathematical analysis and investigation of thermodynamic problems His methods were naturally influenced largely by those of Clausius and the problems he at first interested himself in referred to homogeneous systems He employed the Carnot-Clausius cycle and the Clausius concept of entropy In the prosecution of these earlier studies Gibbs made rapid progress He greatly extended the graphic method of analysis. He invented the system energy, entropy, volume which proved of great value This attracted the attention of Maxwell, whose last effort before his early death was to mould with his own hands a model developed from these three dimensions. This he sent to Gibbs. Gibbs is probably as well known through the graphic methods he introduced as by his more important theoretical contributions

The problems possible of solution by the methods of Clausius and by those of Gibbs up till 1876 were confined almost exclusively to homogeneous systems. Besides, there entered into these analytical methods what further limited their practical applicability, *viz*, the concept of reversibility In reality most of the processes of nature and those most useful to men are irreversible and involve heterogeneous not homogeneous systems To extend the principles of thermodynamics to include non-reversible and heterogeneous systems would be to make them universally applicable This was an exalted vision, yet such a vision was the natural outcome of the progress that had already been made Clausius had expressed this universality in the well-known couplet formulating the first and second law

Die Energie der Welt ist konstant,
Die Entropie der Welt strebt einem Maximum zu.

This couplet—significant of the influence of Clausius, and recognizing no mechanism nor theory—Gibbs used as a text or sub-heading to his memorable paper "On the Equilibrium of Heterogeneous Substances"

The writings of Gibbs, however, show plainly that he early recognized the possibilities that might result from an extension of atomic and molecular theories and the use of statistical methods But he realized also, at the time he was working, the meagerness of definite knowledge then existing for a more extended atomic theory It will be noticed also from a quotation to be made that Ostwald was of opinion that the value of Gibbs's paper rests on the fact that he concerned himself exclusively with energy magnitudes and wisely avoided all kinetic hypotheses.

In the application to life and industry of fundamental principles of science that had already been formulated, the last fifty years have been the most active and productive in the world's history, even though they may not have been the most productive in the discovery of new ones The result of the severe scrutiny and test of those years upon the work of Gibbs is perhaps nowhere better revealed than in the tributes publicly paid to his memory and accomplishments by those qualified to make use of and judge them

That so important a piece of work should remain for fifteen years practically unknown after its publication in America is worthy of much contrite reflection—for the work itself is a model of what American thoroughness joined to vision can be, while its techni-

cal and public neglect over so long a period offers an equally notable example of what American haste and superficiality continue increasingly to be

But some rumor of Gibbs's work finally did reach Europe; Öttingen mentioned it to Ostwald, Ostwald investigated—being particularly interested in the subject of chemical equilibrium. In his autobiography, "Lebenslinien," now being published, he recounts the incident quoted at the Holland celebration

Öttingen had already mentioned to me while I was yet at Dorpat the existence of a work on thermodynamics by an American physicist He had referred to it as significant, but difficult to follow

In order to make myself clear concerning this mightiest of all means (thermodynamics) for developing a theory of chemical affinity, I began the study of Gibbs's paper after no little difficulty in trying to secure a copy of it My experience with the paper tallied with that of Öttingen—I found it difficult to make headway in it, yet I recognized, and that without a doubt, its immense importance Not many had anticipated me in the recognition of this work, previously, only Maxwell in England and van der Waals in Holland had referred to it

There seemed no other way possible for me to gain an understanding of the work than to translate the paper word for word An abstract of it was impossible because it was already so condensed that further abbreviation was out of the question It was also my thought that by a German translation and publication of this long neglected masterpiece it could be brought to light and allowed to take the place that its importance should merit among other investigations

Gibbs's paper proved of the greatest influence on my own development, for—although he did not emphasize the point nor even mention it—Gibbs concerned himself exclusively with energy magnitudes and their factors and avoided completely all kinetic hypotheses By so doing he won for his results a permanence and security that has placed them among the highest products of intellectual attainment. It is a fact that up to the present time, not a single error either in his formulae, his results, nor yet—and this is the most remarkable—in his assumptions has been found Among scientific articles there are to be found not a few wherein the logic and mathematics are faultless, but which for all that are worthless because the assumptions and hypotheses upon which the faultless logic and mathematics rest do not correspond to actuality. In this most important respect the work of Gibbs is free from error

This important work of the gifted American physicist was published by me (with his cooperation) in 1892 (fifteen years after its publication in America) under the title, "*Thermodynamische Studien.*" This was for a long time the only form in which this most significant contribution was available to the scientific world. . . The German edition was soon exhausted and the book has long been out of print. It thus oddly came about that English and American students were obliged to study a work in German originally published but not available in the English language Not until 1906 (thirty years after its first printing and three years after its author's death) Longmans brought out *in England* an edition of the few papers ever published by Gibbs. A German edition is now no longer necessary.

Willard Gibbs was an excessively modest and reserved genius. His entire life, with the exception of a few years spent elsewhere in study, was passed in New Haven, Connecticut, where his father before him was a professor in the university Of his greatness—he is without question the greatest scientific genius the United States has produced—neither the citizens of his native town nor yet of America had any conception He was to be discovered first in Europe This occurred in Holland through the physicist van der Waals—in Germany through Öttingen and myself In Holland an entire school of followers beginning with the student of Bemmelin, Bakhuis Roozeboom, has developed around a single one of the many generalizations that Willard Gibbs arrived at and published in his great work The nucleus of the Holland group is the Phase Law of Gibbs. It was thus that by degrees the scientific world became aware that in Willard Gibbs dwelt a mind worthy to rank along side those of the great physicists Helmholtz, Clausius and W Thompson

The close consideration that I was compelled to give to the work of Gibbs in order to translate it was of great advantage to me Although I was able to follow his mathematical processes only incompletely, I nevertheless acquired from the attempt to follow them an invaluable method of thought I learned the value of the straightforward reality with which he grasped the separate problems and the exhaustive vision with which he marshaled his equations and developed from them far lying consequences Also I could not help but realize that the two hundred equations that his work embraced were, without exception, equations dealing with purely energy magnitudes For me this fact had the greatest significance for it showed that *every fundamental Arbeit must be a work based upon the fundamental laws of energy*"

Besides Ostwald, to whom the memory of Gibbs must owe a special debt of gratitude, many other Europeans participated in the jubilee celebration of the publication of Gibbs's work held by the Holland group

Le Chatelier paid his respects to the memory of Gibbs upon this occasion In his contribution he attributed to Gibbs the rôle of creator and designates his creation as the immense domain of *Méchanique Chimique*. He said

This chapter of science Gibbs created and added to human knowledge where nothing had existed before, and this creation of his was so complete and perfect as it came from his hands that the fifty years that have passed have been able to add little or nothing to it. The numerous savants who have in the meantime concerned themselves with like questions have accomplished

little more than a paraphrase of his work. They have perhaps completed some points in more detail, but more often they have only applied to particular cases laws formulated by Gibbs. Gibbs deduced and expressed his Phase Law in two pages, but there have been published many large volumes recording divers applications of it.

In 1899, twenty-two years after its American printing and five years after Ostwald's German translation appeared, Le Chatelier translated into the French language and published the paper of Gibbs.

An important tribute to the accomplishment of Gibbs was expressed by Professor Donnan, of London, whose notable work on membrane equilibria is one of the manifold applications of the principles formulated by Gibbs and here applied to thermodynamic investigations of life processes. It was Donnan's tribute to Gibbs on the occasion of the centenary celebration of the founding of Franklin Institute that came to many of our countrymen as a matter of news—came as a front page announcement of a great discovery—twenty years after the death of Gibbs. On that occasion he referred to the paper of Gibbs as "one of the mightiest works of genius the human mind has ever produced." In his contribution to the Holland jubilee, instead of dealing with his own special work and the relation it bore to the generalization of Gibbs, he dealt with the great unifying influence of the work of Gibbs as shown in the diversity of its application and in particular he dwelt on its immense practical value to industry. He said:

> The systems with which the chemist is called upon to deal in the carrying out of industrial processes are usually of extreme complexity when viewed from the standpoint of kinetic and electronic theory. The exacting demands of modern life do not allow him to confine his labors to ideal solutions or ideal gas mixtures or to monatomic crystals in the neighborhood of absolute zero. The rapid advances of physics and physical chemistry in modern times undoubtedly hold out the hope that the time will come perhaps in no very distant future when the structure and activity of the material world will be understood in terms of a theory based on the potentialities and activities of electrons, protons and radiation, or possibly of radiant energy alone. Although such a theory already exists in outline, it is not sufficiently developed to suffice for the immediate needs of the chemist who is called upon to devise and control technical processes involving concentrated solutions of complex composition and often containing substances of complex molecular structure. During the past thirty or forty years, however, chemical science has been able to utilize, with immense benefit to itself, that part of physical science known as thermodynamics whereby the most complex equilibria can be dealt with quantitatively without any knowledge of the intimate "mechanisms" underlying physical and chemical phenomena. We owe the first complete and general exposition of the thermodynamics of multiple component systems, especially in relation to heterogeneous equilibria to the pioneer work of Josiah Willard Gibbs in the late seventies of the last century.

Donnan concludes his tribute by quoting from Sir William Pope the words, referring to Gibbs's Phase Law, "Who would have believed thirty years ago that the Phase Rule of Willard Gibbs would to-day be an important accessory to the manufacture of a number of heavy chemicals? Yet the men who learned the principles of this seemingly mathematical abstraction as students have revolutionized a great branch of chemical industry."

The address upon this occasion by Tammann, whose *Fach* is metallurgy and whose interests might seem remote from the physics of life processes that chiefly interest Donnan, contains this sentence:

> Never has an abstract investigation so influenced the fundamental basis of industry as has the treatise of Gibbs on heterogeneous equilibrium.

Such quotations could be indefinitely extended. Those that have been given are not ephemeral; they are based by their authors upon a long and profitable personal experience leading to an ever-increasing knowledge and appreciation of the beauty, utility and value of the work of Gibbs. It has been mentioned that the universality of the principles of heterogeneous equilibrium was fully realized by Gibbs. The extent to which they have been realized in actuality is witnessed by the great number of investigations they have inspired and by their important results. These investigations cover the most diversified fields of human interest. A coordination of them in simple understandable terms would form one of the most interesting chapters in *Naturphilosophie*.

The hearty and sincere tributes of Europe to an American scholar might suggest one basis at least on which international amity is secure. But international amity even on so ideal a basis is not secure the moment the practical application of pure science is made by industry, and by the industry of that nation the best qualified to make application of it. Not only was the value of the work of Gibbs in the field of pure science first recognized by Europeans—the source from which the inspiration of Gibbs was wholly drawn—it was in Europe also that it found its most extensive and efficient application. The laws of heterogeneous equilibrium are the laws upon which are based industrial synthetic processes. Commerce has become familiar with many of its products.

When the possibilities and advantages of industrial appropriation of the results of pure science are in a degree realized from tangible results and the broad highway leading to them prepared and thrown

open to all traffic, many interesting relations are revealed that are not directly recognized as those of pure physics By way of suggestion, the following from Pasteur may be of interest

> Science it is true is of no nationality yet it is the highest personification of nationality Science has no nationality because knowledge is the patrimony of all humanity—the torch that gives light to the world Science should be the highest personification of nation ality, because of all the nations that one will always be foremost that shall be first to progress by the labors of thought and intelligence

F W Stevens

Washington, D C

ARTHUR ARTON HAMERSCHLAG

Arthur Arton Hamerschlag, born in Nebraska, was a native of the West, educated in the East, honored for his work by university degrees and society fellowships He was perhaps most widely known for his advancement of trade and technical educational methods, culminating in the presidency of the Carnegie Institute of Technology at Pittsburgh for a period of twenty years

With the advent of the world war he gave his technical services to his country as advisory assistant to the Secretary of War At its close he returned to technical engineering investigations as president of the Research Corporation of New York, a service closed by death on July 20, 1927, at the age of fifty-eight years

Thus ended a life characterized by breadth of vision, tempered by scientific honesty, keen insight, careful judgment, deep concentration, the results of an analytical mind and ripe scholarship.

He made scientific studies of commercial problems which have added to industrial progress, and his advice was sought in many fields His life was a busy one and many of his studies required a large outlay of time and patience to unravel Yet, with all his duties and urgent demands on time, he was never too busy to give counsel and advice to young men. This phase of his activities is known to those directly affected, but not to the outside scientific and industrial world, where his technical attainments were so well recognized.

These young men were encouraged to do their best work, to seek advancement on merit Their problems were discussed from all angles and solution reached, just as in his work for industrial companies. They reported to him at regular intervals on their work and progress The advice was given in personal interviews and even more by correspondence, usually by return mail. The number of these men would run probably into the hundreds during his lifetime

The results are shown in the high positions in the industrial world now held by these protégés of Dr. Hamerschlag They serve as executives, superintendents, etc., in some of the largest industries. They owe to a very large extent their progress and acknowledge their success as due to this influence

He appeared to take a special delight and pleasure in these reports and in the advancement of these men He delighted in sketching their upward rise in business, though seldom giving the name of the man

Scientific and technical attainments survive and become part of knowledge and science, but the personal influence of a great and helpful man becomes part of life and character Character building is as important, if not more so, than scientific growth, but when both are combined, that man becomes notable.

In a world beset with complexities, worry, toil, the lightening of the load by encouragement and helpful advice to the discouraged is a real humanitarian service

Dr Hamerschlag was a great engineer and educator, he was also a most valuable adviser and spur to greater endeavor to many young men who will miss his help, but who have become better and more successful men by his life, and who are very glad to pay this tribute to his memory

G P Grimsley

Baltimore, Md

SCIENTIFIC EVENTS

CENTENARIES OF 1927

In the London *Times*, as quoted in *Nature*, Professor H J Spooner directs attention to some of the notable centenaries which occur this year Among the names of men of science which he mentions are those of Newton, Laplace, Fresnel, Volta and Lister The bi-centenary of the death of Newton will be celebrated at Grantham in March, while the centenary of the death of Volta is being recognized by the holding of an electrical exhibition at Como The custom of commemorating such events should find general acceptance, for, as Fairbairn once remarked, "the smallest honor we can do the great benefactors of mankind is occasionally to bring them to our recollection " To the names mentioned others are added by *Nature*, which says "Next in interest to mathematicians and astronomers, after Newton and Laplace, comes that of Robert Woodhouse (1773–1827), successively Lucasian professor and Plumian professor, to whom belongs the credit of introducing the calculus at Cambridge and who found earnest disciples in Babbage,

Herschel and Peacock Another astronomer who died the same year was Calandrelli (1749–1827), once director of the Vatican Observatory, while going back four hundrd years we have the birth of Stadius (1527–1579), a predecessor of Kepler as mathematician to the Emperor of Germany. A contemporary of Stadius who should not be overlooked was the famous Dr. John Dee, alchemist and astrologer, who was born in 1527 and died in 1608 To chemists and physicists the tercentenary of the birth of Boyle (1627–1691) and the centenary of the death of Augustin Jean Fresnel (1788–1827) will afford the greatest interest. Though Fresnel sank into an early grave he was one of the foremost students of optics, and it was only eight days before his death that Arago placed in his hands the Rumford medal of the Royal Society Another physicist of note who died in the same year was Chladni (1756–1827), whose works on sound were translated into French through Napoleon. Henry Beaufoy (1764–1827) was both physicist and astronomer, but is still better known for his experiments in naval architecture The year 1827 saw the publication by Ohm of 'The Galvanic Circuit worked out Mathematically' Although no great chemist died in 1827, in that year were born Sir Frederick Abel (1827–1902), John H Gladstone (1827–1902), Edward Nicholson (1827–1890) and, most distinguished of all, Marcellin Berthelot (1827–1907) In the same year the death occurred of Samuel Crompton (1753–1827), whose work as the inventor of the spinning mule will be the occasion of a gathering at Bolton, and also of George Medhurst (1759–1827), one of the inventors of the atmospheric railway Among the great pioneers of last century was Sandford Fleming (born 1827), who was engineer-in-chief of the Canadian Pacific Railway from 1871 until 1880"

THE SEISMOLOGICAL WORK OF THE U. S COAST AND GEODETIC SURVEY

THE most comprehensive survey of earthquakes of the United States, including the insular domain, ever undertaken by the government, is being compiled by the Coast and Geodetic Survey under the supervision of the director of the survey, E Lester Jones

The data are being compiled by the chief of the Division of Terrestrial Magnetism and Seismology, Commander N H Heck, to show the history of all the major disturbances that have been recorded on seismological instruments in United States territory, some cases dating back approximately a century. This information will be embodied in a compendium which will appear in the autumn telling the story of the principal earthquakes in both technical and non-technical language, with a short résumé of the scientific data, grouped by states and sections of the country as well as chronologically arranged.

The survey has recently completed its seismological report for October, November and December, 1925, with supplemental data to complete the record for 1924, and it has begun work for the official complete detailed record of 1926

The 1925 report, prepared by the mathematician of the Division of Terrestrial Magnetism and Seismology, Frank Neuman, with the assistance of Lieutenant J H Service, Ensign F B. Quinn and J D Thurmond, junior engineer, shows that out of 137 earthquakes recorded in United States domain from October 1 to December 31 of that year, the locations of the disturbances were well known or approximately known in 83 cases and uncertain or unknown in the other 54 cases

The distribution of these known locations of earthquakes, by states, follows

California, 17; foreign and submarine, 40, Mexico, 6, Wyoming, 4, Guam, 3, Connecticut, 3, Montana and Nevada, 2 each, Alaska, Hawaii, Maine, New Hampshire, Rhode Island, Washington (State), 1 each.

During that three months' period, seismographs formerly in operation at Vieques, Porto Rico, being thoroughly overhauled, were put in operation in the new Coast and Geodetic Survey magnetic and seismological observatory near San Juan, Porto Rico.

The surveys designed to detect earthquakes in California were continued during that period and a party, under the direction of William Mussetter, operated in the vicinity of the western end of the Santa Barbara channel.

Vessels engaged in survey work are directed to make reports of visible or felt effects of earthquakes but none were reported by them and examination of tidal records from the numerous gauges on the Atlantic and Pacific Oceans disclosed no indication of tidal waves during the three months

The complete seismological summary for 1925 showing "distribution of earthquakes recorded in the United States, the regions under United States jurisdiction and adjacent sections," enumerate 568 earthquakes so recorded during the year 1925, of which 222 were definitely or approximately located (locations officially described as "well-known or approximately known"), locations of 77 being listed as uncertain and locations of 269 as still unknown.

Of these 568 earthquakes, 130 were "provisionally located" as occurring in North America and 43 with some uncertainty in North America, 4 provisionally, and 1 uncertainly, in South America; 3 provisionally, in Europe; 11 provisionally, and 1 uncertainly, in

Asia; 7 in the Atlantic Ocean and adjacent water, provisionally, 60 provisionally, and 32 uncertainly, in the Pacific Ocean and adjacent waters, 7 provisionally in the Indian Ocean, and adjacent waters; 269 unknown.

THE AERIAL SURVEY DETACHMENT

Two aerial survey detachments, each composed of a commissioned officer of the Army Air Corps, who is a photographic pilot, and an enlisted photographer, were recently authorized by the War Department, for the purpose of assisting the U S Geological Survey in carrying out its extensive program for the present calendar year in mapping areas in various states throughout the country

One of these detachments will photograph areas in Maine, New Hampshire and Vermont, approximating 8,000 square miles. A great portion of these areas, particularly in Maine, have never been adequately mapped, and all existing are old and somewhat obsolete The other detachment will begin operations on a 4,000 square mile area in Illinois, and later will photograph areas in Michigan and Wisconsin.

One detachment of this kind, organized last year for a like purpose, photographed during a six months' period approximately 9,000 square miles of territory in the states of Michigan, Wisconsin and Illinois. Through the work of this detachment it is estimated that the saving to the government was approximately $100,000, thus demonstrating the efficacy and economy of aerial surveying

Each aerial survey detachment is equipped with trilens camera and accessories, and furnished with two special photographic planes, one of which is held in reserve. The function of these detachments is to make aerial photographs, which are in turn used in making topographic maps by the Geological Survey The personnel of the detachments is relieved of all other military duties and assigned exclusively to aerial survey activities for a period of six months. It is placed under the direct control of the chief of Air Corps, who is authorized to issue the necessary orders, for its movements and employment, according to the program submitted by the survey

THE CHEMICAL EXPOSITION

FROM the advance information which has reached *Industrial and Engineering Chemistry*, it may be announced that

Many distinctively new and outstanding achievements in chemical engineering, in the manufacture of instruments of precision, in mechanical engineering as applied to the chemical industry, in new apparatus of various and sundry kinds, and, we are happy to say, in new chemicals and new chemical products, will feature the Eleventh Exposition of Chemical Industries, which will open its doors to the public on September 26 at the Grand Central Palace, New York City There will be an extensive exhibit of casein plastics, some of which are new in the field and deserve careful examination. Alloys especially high in their resistance to corrosion will be another point of interest, for some of them have been offered only lately following a considerable period of research. One of the great corporations which has not been prominently identified with this development has recently undertaken some new lines of manufacture, the products of which will be seen at the exposition

This year in a section devoted largely to exhibitors of containers, emphasis will be placed upon packaging, weighing, labeling and handling equipment The subject of containers has long been a troublesome one, for in the past many products of the chemical industry have been marketed in such disreputable packages that attention was directed to the matter some time ago Not only is the use of such packages detrimental from the sales point of view, but in some instances the common carriers have refused to accept some commodities for transportation, not primarily because of their hazard, but chiefly because of the carelessness in methods of packing This unfortunate situation is now much relieved and the exhibits to be found this year at the exposition will prove of great assistance to chemical manufacturers.

Among the exhibits will be found many of distinctly educational nature These include those under the auspices of the American Ceramic Society, the American Chemical Society, the National Safety Council, several bureaus of the United States Department of Commerce and the United States Department of Agriculture Several industries will use the opportunity to promote the education of the public with reference to their products, as for example, the new types of glass which permit a large percentage of the active rays of the sun to pass through them Iowa State College will present evidences of development in the industrial use of agricultural products From the territory represented by such railroads as the Southern and the Southern Pacific Company, and from the Ontario Department of Mines will come interesting displays of natural raw materials from the field as well as from the mine The southern section will include a considerable number of exhibitors, part of which will represent commercial houses and large industries Some three hundred exhibitors are upon the list of those who have engaged space.

SCIENTIFIC NOTES AND NEWS

BERTRAM BORDEN BOLTWOOD, since 1910 professor of radio-chemistry in Yale University, died by suicide on August 14, at the age of fifty-seven years.

FRIENDS of Mr. Thomas A Edison and employees of the Edison interests throughout the country joined on August 8 on the lawn of Edison's home at Llewellyn Park, West Orange, N. J, in honoring the inventor, who fifty years ago completed the first mechanism for

recording and reproducing sound Governor A Harry Moore, of New Jersey, was among the guests and presented to Mr Edison a bound portfolio of letters of felicitation received from prominent men and women throughout the world

DR CHARLES ATWOOD KOFOID, chairman of the department of zoology at the University of California, has been elected president of the Pacific Division of the American Association for the Advancement of Science, Dr Joel H Hildebrand, professor of chemistry, and Dr Leonard B Loeb, associate professor of physics, have been appointed members of the executive committee

ON the occasion of the meeting of the British Association for the Advancement of Science, the University of Leeds will confer the doctorate of laws on Sir Arthur Keith, president of the association, on the Duchess of Atholl, and on the Hon Sir Charles Parsons, and the doctorate of science on Dr J B S Haldane, Dr N V Sidgwick, Dr F O Bower and Dr R A Millikan

THE fifth gold medal of the African Society, instituted for those who have done the best work for Africa, has been awarded to Sir Ronald Ross, director-in-chief of the Ross Institute and Hospital for Tropical Diseases

M CHARLES FABRY, professor of physics at the Sorbonne and director of the institute of optics of the University of Paris, has been elected a member of the Paris Academy of Sciences in the section of physics to succeed the late M Daniel Berthelot

M GRAVIER has been appointed a delegate of the Paris Academy of Sciences to the International Congress of Zoology, which will open in Budapest on September 9

DR EMMELINE MOORE, of New York, was elected president of the American Fisheries Society at its recent convention at Hartford, Connecticut. Other officers elected were C F Culler, of the U S Bureau of Fisheries, *vice-president*, Carlos Avery, secretary of the American Game and Protective Association, *secretary*, and T E Pope, of the Public Museum of Milwaukee, *treasurer* Next year's meeting will be held in Seattle, Washington

DR. F L CAMPBELL, assistant professor of biology in New York University, has resigned to accept a position as associate entomologist in the Bureau of Entomology, Washington, D C, where he will investigate the toxicology of stomach poison insecticide

J D RUE, chief of the pulp and paper section of the U S Forest Products Laboratory, will leave the laboratory about September 15 to take the position of director of research for the Champion Fibre Company, of Canton, N. C Mr Rue has been in charge of the pulp and paper section of the Forest Products Laboratory since 1921

DR PETER H BUCK (TE RANGI HIROA), director of Maori Hygiene for the New Zealand Government, has been appointed anthropologist on the staff of Bernice P. Bishop Museum, Honolulu During 1927–28, Dr Buck plans to give his attention chiefly to investigations in the Cook Islands, in continuation of previous studies Gerrit P Wilder, botanist on the staff, has returned to the United States after a year's study of the breadfruit trees in the Society and Cook Islands Mr John W Gillespie, Bishop Museum fellow in Yale University, is making a botanical survey of Viti Levu, Fiji, with especial attention to the flora of high altitudes In this investigation, he is associated with Mr H E Parks, of the University of California, who has been at work in Fiji for the past three months Mr H G Hornbostel, who for the past three years has been engaged in archeological field work in Guam and the Marianas Islands, under the auspices of the museum, has begun similar studies in the Caroline Islands

DR WALTER H EDDY, professor of physiological chemistry at Columbia University, has returned from a half year's leave of absence which he spent in Spain, France, England, Barbadoes, Trinidad, Costa Rica, Panama and Cuba.

DR CALVIN O ESTERLY, for twenty years professor of zoology in Occidental College, has been granted a leave of absence for the academic year 1927–28 Dr and Mrs Esterly plan to go to Hawaii in August

H S LADD, of the University of Virginia, is engaged in studying the fossil mollusks of the Fiji Islands and will later spend about a month at the National Museum

H D SKINNER, of the department of anthropology of the University of Otago, Dunedin, New Zealand, was recently the guest of the Pueblo Bonito Expedition of the Smithsonian Institution

DR JAMES MUIR, radium therapist, sailed for Europe on August 6 to read papers and give clinical demonstrations on his treatment of cancer by radium implantation at the four leading European capitals.

LEAVE of absence has been granted to Dr Arthur H Compton, professor of physics of the University of Chicago, from October 1 to November 10, in order that he may attend the Solvay Congress, and to Derwent S Whittlesey, associate professor of geography, for the autumn, winter and spring quarters, 1927–28, in order that he may take charge of the work in geog-

raphy on the second round-the-world cruise to be conducted by New York University

DR. EDWIN G CONKLIN, of Princeton University, recently lectured at Columbia University on "Heredity *versus* Environment in Human Progress" and on "Some Common Misconceptions regarding Evolution," and at the Mount Desert Botanical Laboratory in Maine on "The Evolution Controversy in the United States"

DR FRANCIS G BENEDICT, director of the nutrition laboratory in Boston of the Carnegie Institution of Washington, gave an address at the University of New Hampshire, recently, on "Physiologic Research Institutions of Europe"

DR ALEXANDER CROMBIE HUMPHREYS, for twenty-five years president of the Stevens Institute of Technology, well known as a gas engineer, died on August 14, aged seventy-six years

LOYALL VERGIL HUNT, B S., Kansas State Agricultural College, 1923, student assistant in zoology at West Virginia University, was drowned on August 7 while bathing in the Cheat River near Morgantown

SIR BRYAN DONKIN, honorary member of the Royal Medico-Psychological Association, and author of many publications on criminology and related subjects, died on July 26, aged eighty-two years.

DR ALBRECHT KOSSEL, professor of physiology in the University of Heidelberg, known for his contributions to our knowledge of the chemical nature of the proteins, died on July 5, aged seventy-four years

DR PAUL KESSLER, associate professor of geology at the University of Tubingen, died on July 14

THE United States Civil Service Commission announces open competitive examinations to fill vacancies in the U S Department of Agriculture as follows Junior crop and livestock estimator, in the bureau of agricultural economics, for duty in Washington, D C, or in the field, at $1,860 a year, and associate dust explosion prevention engineer at $3,000 a year, and assistant dust explosion prevention engineer at $2,400 a year, in the bureau of chemistry and soils.

IT is reported in the *Journal* of the American Medical Association that the residents of Pine Grove are seeking an injunction to prevent the establishment in that community of a research laboratory by the state of Montana for the purpose of investigating the prevention of Rocky Mountain spotted fever, it being reported that they have instituted court proceedings, making members of the state board of health the defendants. Dr William F. Cogswell, secretary of the state board of health, testified on July 29 that there would be no chance for the experimentally infected ticks to escape from the proposed laboratory. The question of how fast these ticks travel is said to have enlivened the court proceedings

THE Illinois State Geological Survey has recently received from the legislature, with the approval of the governor, an increased appropriation, which will permit an extension of specialization in petroleum engineering and geological engineering and the undertaking of a comprehensive paleobotanical study of the Pottsville series, in addition to its regular program of stratigraphic, glacial and economic studies The paleobotany of the Pottsville series will be studied by Dr David White The previous appropriation of $50,000 per year for topographic mapping was continued

THE topographic maps made by the Geological Survey of the Department of the Interior show by means of contour lines, of which there are thousands on some maps, the altitude above sea-level of every portion of the area represented In addition to portraying all physical characteristics, as well as the works of man, these maps constitute a wonderfully detailed dictionary of altitudes, showing the height of every hill and slope As the United States becomes more and more completely mapped, the scope of this "dictionary" constantly expands At the present time a little more than 40 per cent of the United States is topographically mapped, but the work is progressing rather slowly at the rate of only 17,000 or 18,000 square miles a year Moreover, the maps of a large part of this area are either very old, and therefore somewhat crude, or else on so small a scale as to be inadequate for present-day needs In addition to areas that have never been surveyed, there are considerable areas that will have to be resurveyed

WE learn from *Nature* that in *Man* for July, Professor Frassetto, of Bologna, figures and describes his reconstruction of the jaw of Piltdown man, which he compares and contrasts with the jaws of the orang and the chimpanzee In his view its resemblance lies in the direction of the orang rather than that of the chimpanzee. He gives in tabular form eight points in which the orang differs from the chimpanzee, and in which the jaw of Piltdown man, so far as its condition allows, is comparable with it As a whole, the jaw of the chimpanzee is relatively thin, slight and light, while both orang and Piltdown are massive and heavy; the ascending ramus is oblique in relation to the horizontal portion, but in the orang and Piltdown almost vertical, the position of the semilunar notch coincides in the two jaws, but in both differs from its position in the chimpanzee jaw; the angle has a curvature of a large radius in orang and Eoanthropus, but it is small in the chimpanzee; the posterior margin of the chimpanzee ramus is narrow to the root of the

condyle, where it widens rapidly, but in both the other jaws it widens gradually as it passes into the condyle. Again, the lower borders of the corpus of the mandible resemble one another in both orang and Piltdown, but differ from the chimpanzee, which also has a relatively small genial fossa as opposed to the large fossa of the other jaws The reconstruction was therefore made by grafting the symphysian region of the orang's mandible duly enlarged on to the corpus of Piltdown man's jaw, the conclusion being that the jaw is human, belongs to the same individual as the cranial fragments, and represents a primitive race belonging to a genus of the orang type Not only is this because of the features of the mandible, but also because of the eyebrow ridges, which do not exhibit the prominent torus characteristic of the chimpanzee type to which Neanderthal man belongs

THE results of an investigation into certain processes and conditions on farms undertaken by Mr. W. R. Dunlop, under the auspices of the National Institute of Industrial Psychology, are reported in *Nature* as follows "These results show that farm management in Great Britain is by no means efficient. The present investigation is the first systematic attempt in Great Britain to apply the point of view and methods of industrial psychology to agriculture Two problems were studied (*a*) the picking and packing of fruit, including bush fruit, hops and glass-house produce, and (*b*) milking It is shown that the best pickers at one kind of fruit are the best pickers at all other kinds, that there is no evidence to show that afternoon rates are lower than those of the morning, that there are considerable individual variations in efficiency The milking problems include discussions of milking rates, differences of cows, manual skill of milkers Some important questions are raised in the third section dealing with future enquiries, not the least of which is the selection of the right worker for the right work, and the guidance of young people leaving school into occupations for which they are most fitted Apparently there is a tendency for the children of a lower level of intelligence and ambition to take up agriculture, the town attracting the more intelligent In so far as this is so, it is to be deplored, but obviously the problems connected with such a choice are very difficult to attack, involving as they do the attitude of mind of the community towards agricultural work, the lower standard of nominal wages and the ties with regard to hours"

UNIVERSITY AND EDUCATIONAL NOTES

BY the will of the late Dr Charles A. Dewey his estate of nearly $1,000,000 is to be held intact as the Charles A. Dewey Fund, the income to be devoted to the support of the medical schools of the University of Rochester and of Harvard University Dr. Dewey graduated from the University of Rochester and from the Medical School of Harvard University in 1880. In addition to the foregoing provision, which became effective through the recent deaths of a nephew and niece, the will provides a gift of $100,000 to the Rochester General Hospital as a memorial to Dr. Dewey's sister

AS a result of a decision handed down by John P O'Brien, surrogate of the New York County Court, Dartmouth College eventually will receive $373,024 from the estate of Mrs Helen L Bullard The will had been contested on the ground that the decedent estate law prohibits the payment of more than one half of an estate to charitable or educational institutions when there are immediate members of the family living at the time of the passing of the testator It was ruled that the value of the Dartmouth remainders should be computed at the time of the death of Mrs Bullard upon the life expectancy of the thirteen life tenants as shown in insurance tables

DR. RAYMOND M HUGHES, for sixteen years president of Miami University at Oxford, Ohio, has resigned to accept the presidency of the Iowa College of Agriculture and Mechanic Arts at Ames

AMONG the promotions to full professorships announced by the University of Chicago Board of Trustees are the following Ernest W Burgess, in sociology, Fay-Cooper Cole, in anthropology; Arthur J Dempster, in physics; Edward Sapir, in anthropology, William Taliaferro, in pathology, and Louis Leon Thurstone, in psychology. Promotions to associate professorships include Merle C Coulter, in botany, Maude Slye, in pathology, and Benjamin A Willier, in zoology

DR. W. MANSFIELD CLARK, of the Hygienic Laboratory of the U. S Public Health Service, Washington, D C, has accepted the position of professor of physiological chemistry at the school of medicine of the Johns Hopkins University

DR. THOMAS MURRAY MACROBERT, university lecturer in the University of Glasgow, will succeed Dr. Gibson as professor of mathematics

DR. ERWIN SCHRÖDINGER, of the University of Zurich, has been called to the University of Berlin as the successor of Professor Max Planck.

DR. REINHARD DEMOLL, director of the biological laboratory at the University of Munich, will succeed Dr. Karl Grobben as professor of zoology in the University of Vienna.

DISCUSSION

THE QUANTITATIVE THEORY OF SEX

IN a recent note in SCIENCE (Vol 65, p 596) Dr. R. Goldschmidt comments on an earlier communication in which the present writer (SCIENCE, Vol. 65, p 139) questioned the completeness of Dr Goldschmidt's proprietary rights to "The Quantitative Theory of Sex"—as claimed or implied in his initial request for "acknowledgments" from the "Columbia school" (SCIENCE, Vol 64, p 299). It was our purpose to point out that "Goldschmidt can properly claim precedence" in the elaboration of "a quantitative theory of normal sex determination," but not for "the quantitative theory of sex as this has developed during the last fifteen years" In his reply Goldschmidt not only fails to assist in the clarification of this essential point, but he turns the discussion to fragments—considered by him as wholes—of various aspects of the work of Riddle which, he is distressed to find, afford "no proofs" of either "experimental intersexuality or experimental sex-reversal" The original point is a matter of interest to a relatively large group of workers, and some of his misstatements concerning studies made in our laboratory require a word of comment

Quite apart from any question of the adequacy of supporting facts, and wholly irrespective of whether one or a dozen workers obtained the results upon which the theory is based, it is simply a fact that a quantitative theory of sex exists apart from, and was founded before, any theory of Goldschmidt's on quantitative sexuality. Further, it is a fact, sufficiently known to workers in this field, that the present writer has taken a not negligible share in the formulation of this theory, being specifically responsible for a series of views concerning the relation of metabolic rate to sex Namely, that such a difference extends to the two kinds of gametes produced by the heterogametic sex, that here the prospectively male gametes show the higher, female gametes the lower metabolic rate, that a difference in this same direction also characterizes later (embryo and adult) stages of the development of sex, that such metabolic differences can, in experiment, override the normally controlling influence of the chromosomes—thus resulting in the sex-reversal exhibited in several animal forms; that the sex chromosomes or genes probably exercise their normal sex-determining function by aiding the establishment of a higher and a lower metabolic rate; that intersexes and hermaphrodites can arise from chromosomal or genic causes, but they can arise also from a metabolic cause while chromosomes and genes are normal; and that the metabolic distinction found can not be interpreted as a secondary sex character.

The evidence on which this theory is based has, practically from the beginning, rested on the results not only of Whitman-Riddle in doves, but those of the Hertwig school on frogs, of G Smith on crabs, and still other work. It included the much older facts and idea of Geddes and Thomson, and had indeed such a background of varied and promising fact that it is little wonder that the great advances since made—including some more recent and still unacknowledged interpretations of Goldschmidt—have definitely turned in this direction

In his book, Goldschmidt (1923, p 116) says "In the case of insects intersexuality could only be obtained through abnormal zygotic constitution, because the production of hormones is not localized in special organs, but takes place within the individual cells In the other group (vertebrates) it is possible to obtain intersexuality independent of the zygotic constitution because the hormone production is localized in organs which can be removed or transplanted, and their action independently of the zygotic constitution which originally called them forth can in this way be investigated" If then intersexuality in insects—with which Goldschmidt worked—can only be obtained by "abnormal zygotic constitution" (hence, no plasticity here), are we not correct in placing Goldschmidt's results as important to the theory of "sex-determination," and "unimportant to the quantitative theory of sex as this has developed in the hands of others" (in whose vertebrate material plasticity is found)? Truly enough, "some of Riddle's arguments are based on work in hybridizing doves" but we think —though very erroneously, says Goldschmidt—we find a plasticity in a part of our vertebrate material indicating that one and the same zygotic constitution here does not deliver equivalent sexuality but varies according to identifiable conditions, and we have measured the concurrent gametic metabolic change that coincides with this plastic change of sex Goldschmidt's results fall far short of this (since by his own admission "intersexuality could only be obtained through abnormal zygotic constitution"), and for this reason—not because "they happen to be found by Goldschmidt" instead of by Riddle—his results are unimportant to the quantitative theory of sex now under discussion.

The different gradations in sex behavior produced and measured by us in doves are entirely discarded by Goldschmidt as evidence of intersexuality He wants "morphological" mixings After wondering how, on Goldschmidt's view, psychologists and psychiatrists could ever become acquainted with "sex" in their fields—and leaving the question to our colleagues and the future—we may note that Goldschmidt should read more and better before suggesting that graduated intersexual behavior is "the only fact" provided by us for intersexuality We freely

admit that we have thus far given only short and incomplete accounts of the many kinds and cases of intersexuality encountered in our material. We acknowledge and regret, and are steadily supplementing, this incompleteness. But morphology, beloved of Goldschmidt, is I presume adequately represented by oviducts in males (*Anat Rec*, 1925, 31, p 349), by persistent, even functional, right ovaries in females (*Amer Nat*, 1916, 50), and by the hermaphrodites listed (Whitman, 2, 1919), or referred to in connection with rather full descriptions of some other abnormal (possibly not intersexual) gonad conditions (*Brit Jour. Exp Biol*, 1925, 2). If these, as yet little described, cases of hermaphroditism should lead our critic to dispose of them by the further assertion that Riddle can not properly recognize an hermaphrodite he is entirely welcome to that position.

Goldschmidt states that our "claim to the experimental production of sex-reversal by reproductive overwork and by crossing . . is based on the assumption that the first egg of a clutch is male, the second female." This is simply not true. "Our studies on 'sex control' manage to get on whether the eggs come in normal order, reversed order or utter disorder" (*Amer Nat*, 1925, 59). Also, according to Goldschmidt we have "never proved experimental sex-reversal or made it even probable." Waiving the large question of proofs, we may note that calculation of probabilities in a single result obtained in one of our very few "family" crosses indicates that—apart from sex-reversal—this result "could be expected to occur only once in 9,384 trials" (*Anat Rec*, 1925, 31). So apparently, either Goldschmidt must read more, or in my items of data I must eliminate part of *one* chance in 9,384.

To say that "Riddle's theory of sex determination by different metabolic rates . . fails in the normal case of male heterogamety, it fails in such cases of female heterogamety as the gipsy moth, etc.," is merely to use words without meaning. The theory was founded upon forms showing "female heterogamety" (pigeons), and early applied, successfully we think, to forms (frogs) which later proved to show "male heterogamety", moreover, as earlier pointed out, parts of this metabolic theory were later borrowed and lugged unacknowledged into Goldschmidt's own theory of sex-determination in the gipsy moth.

Well or ill founded—and much in addition to work with pigeons forms part of its foundation—there exists a vigorous quantitative theory of sex, based on real or fanciful sex-reversal and intersexuality apart from zygotic composition (on which Goldschmidt's studies are based), and on measurements of metabolic sex distinction in all stages—ovum to adult. We and others have taken a good or a bad part in all this, and the quantitative theory of sex can not be properly discussed—as Goldschmidt would have it—as the private affair of the "Columbia school" and the laboratory of Goldschmidt.

OSCAR RIDDLE
CARNEGIE STATION FOR EXPERIMENTAL EVOLUTION,
COLD SPRING HARBOR, L. I.

ZOOLOGICAL NOMENCLATURE

REFERRING to the recent referendum on Dr. Poche's (Vienna, Austria) three propositions in regard to the Rules of Zoological Nomenclature, the undersigned has the honor to report to the zoological profession the following results of the ballot:

Poche's proposition I	8 votes for,	549 votes against.
Poche's proposition II	4 votes for,	550 votes against
Poche's proposition III	4 votes for,	551 votes against

A detailed report will be made to the Tenth International Zoological Congress (Budapest) and the undersigned unreservedly accepts the unambiguous results of this referendum as definite instructions from the profession in the United States for him to cast his vote (in the congress as delegate, and in the commission as member) against all three propositions.

C W STILES,
Professor of Zoology, U. S. Public Health Service

"OPALINA ELONGATA" GOURV. IS CEPEDEA SAHARANA METCALF

V GOURVITSCH describes as new an Opalinid from "*Rana ridibunda*" from Tashkent, Turkestan.[1] He names this "*Opalina elongata*." It is a *Cepedea* and from his description seems to be the form I have described as *Cepedea saharana* from *Rana esculenta ridibunda* collected at Biskra, Algeria.[2] It seems well to call attention to this to prevent confusion.

MAYNARD M METCALF

QUOTATIONS

PUBLICITY AND SCIENCE

IN this day of personal horn-blowing it is refreshing to come upon a group of men who are doing great things, yet who shun publicity as they would the plague. As a matter of fact, they would not shun the

[1] V Gourvitsch. The protozoan fauna of the intestines of frogs from the vicinity of Tashkent—in the *Bulletin* of the Government University of Central Asia, No. 14, 1926. [Russian]

[2] M. M Metcalf. "The Opalinid Ciliate Infusorians," United States National Museum, No 120, 1923.

plague They are engaged in a fight against cancer, which is far more persistent and no less deadly.

There was an account in Thursday's *Evening Post* of the work accomplished by physicians of the Memorial Hospital, to which Edward S Harkness recently gave $250,000 for the purchase of four more grams of radium From this publicity Dr James Ewing, director of cancer research at the hospital, shied as though one were asking him to give a trapeze performance About a year and a half ago, when the new treatment was first announced in the press, Dr Herbert A Quick, who has directed its application and has had much to do with its development, is said to have acted as though he were being disgraced Mr M Failla, the laboratory worker whose suggestion it was that gold instead of glass be used in the "seed" tubes now implanted in cancerous growths—a vital element in the new treatment never before has been publicly mentioned in connection with the discovery Nor has Dr Max Cutler, who first worked out the problem on animals before it was applied to human beings

There is a deep-seated prejudice against publicity, the heritage of many of the ablest men in the medical profession, which plays its part in the suppression of information which should be presented to the public One of the most important reasons for this feeling lies in the constant flood of "claims" which second-rate scientists make of "discoveries" and "cures" Some of these announcements are made through overenthusiasm and some through a desire to take advantage of the public's ignorance of science.

Hence the practice has grown up among men of science of not making public announcements of their findings until they have been presented before groups of leading men in the profession, who can discuss and criticize them in the full light of scientific knowledge before the public is informed This is a wholesome procedure But the fear of publicity is carried too far when leading men are afraid to speak for publication even after their work has been tested in the scientific society's conferences and in the laboratories of coworkers, simply because they fear criticism from members of their own profession

It is largely because of the reticence of the men best qualified to speak that those not nearly so well qualified occupy so much of the newspaper space devoted to science It is also partly because of this reticence that publicists have conceived the notion that the public wants its science information jazzed up and distorted. The public never was so hungry for authentic information as it is to-day If men of science were to speak freely where they find a disposition to report news of science sanely an *entente cordiale* between science and journalism would be established which would be of inestimable value to both—and to the public.—*New York Evening Post*

SCIENTIFIC BOOKS

Collected Papers of Sir James Dewar. Edited by Lady Dewar. Vol I 27 × 17 cm, pp xxii + 674 Vol II 27 × 17 cm, pp ix + 814 Cambridge and New York The Cambridge University Press, The Macmillan Company, 1927

To many chemists Dewar is known as the Englishman who specialized in low-temperature work and as the man who invented the thermos bottle Only relatively few know much about his spectroscopic work in collaboration with Liveing and yet his high-temperature work began in 1872 and was continued up to 1889 Since the first low-temperature paper was published in 1884 and since Dewar was appointed Jacksonian professor of natural philosophy in the University of Cambridge in 1875 and Fullerian professor of chemistry in the Royal Institution of Great Britain in 1877, it is evident that he had made a distinguished name for himself before he ever started on low-temperature work

New to most people will be the work on the physiological action of light, on electrophotometry, on capillarity and on the properties of nickel carbonyl A good many people know that he collaborated with Moissan in studying the properties of liquid and solid fluorine

What very few people realized, outside of his personal friends, is the surprising versatility of the man When he studied low-temperature problems, for instance, he covered the whole range It was not merely a question of developing improved methods of liquefying gases and of determining melting points, boiling-points, and densities Dewar studied specific heats, latent heats of vaporization, diffusion, adsorption by charcoal, optical and magnetic properties, color, photochemical reactions, the effect of low temperatures on bacteria and on electrical resistance, etc, etc It is a real pleasure to note how many sides Dewar saw to a problem Everybody knows that Dewar was a marvelous manipulator, and this fact is impressed on the reader because, in these volumes, one runs the whole gamut in so short a time.

It is interesting to note Dewar's attitude towards physical chemistry as far back as 1888. "At the present time we may say that there are two large schools of chemistry one school cultivating organic chemistry, in which structural or atomic building up of an atomic character is carried out on a gigantic or manufacturing scale, producing thousands of new bodies every year, and continually increasing in the energy of its work and the variety of its produc-

tions. On the other hand we have another school in which physical chemistry is predominant, where the physical relations of chemical action are minutely examined, and where the effect of the physical relations of the constituents taking part in chemical changes is being more and more elaborately studied," p 307.

Physical chemistry, as Dewar used the term, started with Black whose early lectures were entitled "Lectures on the Effects of Heat and Mixture" "Black used to institute a parallel between the phenomenon attending the hydration of lime and that which occurred when steam was condensed to water, both being accompanied by an evolution of heat and a change of state. The one might be called a chemical change, but for him it was analogous to the simpler change of physical state involved in the other," p 313

"The chief idea [in the set of experiments made by van't Hoff] is to correlate concentration with varying gaseous density, so that the reactions of salt solutions are brought into harmony with gaseous reactions. This is the work which van't Hoff has attempted, and very remarkable it is to consider the concentration of a solution containing a certain quantity of a salt as if the substance was in the gaseous state, and prove that the pressure of the dissolved solid is practically the same as if it had been volatilized into the same volume. Thus a new view has been opened up which brings into harmony the whole question of solutions of varying concentrations and the laws regulating their reaction," p. 314.

In 1899 Dewar published a diagram, p 687, showing that the extrapolated resistance of a platinum resistance thermometer is zero at about $-245°$ C, and he concludes that probably the resistance curve becomes practically asymptotic to the temperature axis In 1902 he comes back to the subject in his presidential address to the British Association, p. 785 "All known liquids, when forced to evaporate quickly by being placed in the exhausted receiver of an air pump, undergo a reduction in temperature, but when hydrogen was treated in this way it appeared to be an exception The resistance thermometer showed no such reduction as was expected, and it became a question whether it was the hydrogen or the thermometer that was behaving abnormally. Ultimately, by the adoption of other thermometrical appliances, the temperature of hydrogen was proved to be lowered by exhaustion as theory indicated Hence it was the platinum thermometer which had broken down, in other words the electrical resistance of the metal employed in its construction was not, at temperatures about $-250°$ C, decreased by cold in the same proportion as at temperatures about $-200°$. This being the case, there is no longer any reason to suppose that at the absolute zero platinum would become a perfect conductor of electricity, and in view of the similarity between the behavior of platinum and that of other pure metals in respect of temperature and conductivity, the presumption is that the same is true of them also" This conclusion was unfortunate because Kamerlingh Onnes showed, some years later, that the electrical resistance of gold, mercury, and platinum vanishes at the temperature of boiling helium, p 1103

Dewar was once the victim of the misleading experiment. In 1873 he determined the vapor density of potassium in an iron vessel and found that the molecular weight corresponded to the formula K_2, p. 72 In 1879 he repeated the work, using the Victor Meyer method which had been described the year before The molecular weight varied from 74 4 to 90 5 with a mean value of 81 6 as against 78.2 calculated for K_2 Sodium gave values varying from 40 9 to 63 6 with a mean molecular weight of 50 7 as against 46 0 for Na_2 "Four pieces of potassium weighed in iron capsules and thrown into water gave 84.2 as a mean molecular weight, calculated from the hydrogen evolved. Four pieces of sodium similarly treated gave 49 8 as a mean The above experiments show that no great accuracy in the determination of the vapor-density of sodium and potassium can be attained by this method of working when vessels of wrought iron are employed. The results are, however, conclusive as regards the *normal character of their respective vapor-density*," p. 177. Later in the same year Dewar and Scott repeated these experiments, using a platinum vessel, getting mean molecular weights of 26 4, 25.8, and 24 9 for sodium, and of 44 0 and 40 7 for potassium. "The new determinations of the molecular weights of potassium and sodium are just about half the former values, and would seem to support the inference that the atom of each of these metals resembles mercury and cadmium in the gaseous state, as regards molecular volume. Such a remarkable result can not be accepted without a very thorough investigation of the secondary reactions which may be induced at high temperatures It is certain that in the platinum vessels there is much less absorption of vapor than in the case of iron, and that the action of the furnace gases is all but eliminated," p 183

Under Pictet's experiments on the liquefaction of hydrogen, we read, p 169, that "hydrogen in the liquid state at a temperature of $-140°$ has a pressure of about 320 atmospheres and appears to solidify in the tube when the fluid jet is allowed to escape The jet of liquid has a steel blue color." The color was not surprising in those days when it was thought

that solid hydrogen was probably a metal We know now that hydrogen is colorless both as solid and as liquid. Consequently the steel blue color was either due to an impurity or was a structural color

In a paper on "The Coming of Age of the Vacuum Flask" in 1914, Dewar points out that as far back as 1873 a highly exhausted annular metallic vessel was used by him in calorimetric experiments. It was not until 1893, however, that he described the use of glass vessels During the war the all-metal thermos bottle was developed, thus harking back to the original type.

While one can not fail to be impressed by the brilliancy and versatility of Dewar's work, it is surprising that there is so little in the way of theory The truth of the matter seems to be that Dewar was what the reviewer has called an accumulator rather than a guesser He was intensely interested in experimentation and he did not care at all for the theoretical bearing of the experiments. He did a good deal of work on adsorption of gases but he never cared about the laws of adsorption This appears even more strongly in his work on soap films The results are fascinating and are veritable triumphs of experimental ingenuity Bubbles were blown four feet in diameter which lasted several hours, one bubble, 46 cm in diameter, lasted sixty-three days, and a horizontal black film, 20 cm in diameter, lasted for a year Dewar gives all details, but he draws no theoretical conclusions from them and makes no effort to do so.

Wilder D Bancroft

Cornell University

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE GINS METHOD OF DEMONSTRATING CAPSULES OF BACTERIA

While using the Burri India ink method of studying bacteria, especially for demonstrating the various forms of the diphtheria bacillus, the idea occurred of attempting the demonstration of capsules of bacteria through staining of the India ink films The method was tried with excellent success. Subsequent search of the literature has shown that the method in all its essential details has been described previously by Gins.[1] Since the method has worked out very well in class use and does not appear to be generally known in this country, I am giving the technic for the information of others.

The ordinary India ink sold in this country for drafting purposes can be used for this purpose providing it is free of bacteria. This, however, was not the case in several samples recently purchased, there being large numbers of organisms present. An ink which is prepared especially for the purpose is that of Grübler, known as Pelikan tusche No 541 This ink probably contains a preservative since bacteria have been absent in the samples examined

The ink usually works better when it is diluted with an equal amount of sterile distilled water A drop of the diluted ink is placed near one end of a very clean slide and a loopful of the bacterial suspension is carefully mixed with it The mixture is then spread across the slide with the edge of a second as when making a blood smear A properly made preparation should be uniformly spread and of a grayish color rather than black After drying in the air, the film should be fixed by heating or preferably by dipping in methyl alcohol The slide may now be stained with any of the ordinary bacteriological stains including the Gram method If the film is too thick it sometimes loosens after fixation, but properly spread films seldom give any trouble in this respect A cover-glass may be used to protect the film but such protection is not needed if the slide is carefully handled

Under the microscope well-stained organisms can be seen lying in lacunae in the film of ink. The margin of the capsule is sharply delineated by the ink, and the margin of the bacterial cell is sharply delineated by the stain Between the two is a clear space which represents the capsular substance. If the film of ink is too thick, shrinkage of the film may produce separation of the ink from the cell wall, thus giving rise to an artifact which resembles a capsule. When the ink is properly diluted this difficulty has not been met with.

This method has been used successfully in class work using the Friedlander bacillus, the anthrax bacillus and the pneumococcus as test organisms The anthrax organism shows a thin capsule even in cultures which have been continuously in artificial media for many generations A similar capsular substance has also been evident in the streptococcus cultures which have been examined by this method These organisms do not show any evidence of capsular substance when examined by other capsule demonstrating methods and are not capsulated in the ordinary sense of the word. Apparently some sort of intercellular substance exists in all chain-forming organisms and it is this material which is demonstrated by this method

William A. Hagan

N Y. State Veterinary College, Cornell University

[1] Centralbl. f. Bakteriol., Parasitenk. u. Infektionskrankh. Abt. I Orig. 1911, Bd. 57, 477.

RESEARCH NOTES FROM THE HARVARD OBSERVATORY

New star in Sagittarius In the constellation Sagittarius, the "home of galactic novae," a new star has recently been found by Miss Gill, on photographs made at Arequipa, Peru It appeared suddenly at the eighth magnitude on June 22, 1924, and during the succeeding three months, in the ordinary course of the sky patrol, was unknowingly photographed seventeen times as its light steadily decreased beyond the range of the Arequipa telescopes The star fails to appear on some fifty patrol photographs of the region made since September, 1924, and it is also completely absent from more than three hundred photographs of the region extending throughout the twenty-five years preceding its outburst

Of the fifty or so galactic novae, nearly twenty have been discovered on Harvard plates of Sagittarius and the immediately surrounding constellations The high concentration of catastrophes in one region is due, I believe, to the fact that these constellations lie in the direction of the center of the Galaxy and provide, therefore, a deep hunting ground for novae An alternative explanation of the frequency of novae depends on the abundance of dark nebulous clouds that might contribute to the explosive unbalancing of involved stars, but such nebulosities are numerous in other parts of the sky where novae are rarely or never found

Cosmic rays The source of penetrating radiation is a problem that is exciting considerable attention of physicists and astronomers just now—perhaps too much attention, for in some quarters the actual existence of the highly exciting cosmic rays is yet doubted The measures by Kohlhorster and others in Europe of the intensity of the radiation and of its variations from day to day and hour to hour are not in too good agreement with results by Millikan and collaborators in America But granting the existence of this agent that discharges highly protected electrometers, it is of importance to seek its origin and particularly to study the probable cosmic effects.

Professor Gerasimovič has taken up at Harvard the theoretical study of cosmic rays, and one of his investigations, which is just published (H. B 847), concerns the hypothesis of Corlin that the source of the cosmic radiation lies in the long period variable stars, such as Mira There are hundreds of these stars, mostly faint, undergoing variations of several magnitudes in periods of a few hundred days. They afford, indeed, a plausible source of extremely short wave length radiation, because of their low atmospheric density (being very diffuse, red, gigantic stars) and also because hydrogen is an unduly conspicuous element in their spectra and therefore available for the hypothetical synthesis of chemical elements which might give rise to the extreme radiation-inciting energy changes Corlin sought to correlate the observed variation in the intensity of penetrating radiation and the variation in the number and total brightness of long period variables above the horizon at corresponding times of the day

The great number of current observations of long period variable stars, available through the work of the American Association of Variable Star Observers, permits a ready and definite calculation of the total brightness of the variables at any given time In fact, Mr Campbell's predictions, published bimonthly and annually from Harvard, permit this calculation for a year or so in the future Carrying out the analysis, Gerasimovič finds no correlation between the stellar radiation and the cosmic rays Moreover, he shows that the radiation of cosmic rays would need to be four times as intense as the black body radiation of the same stars to account quantitatively for the daily disturbance of penetrating radiation as recorded in Europe If the diurnal variations exist, we conclude that they are not closely associated with the behavior of the variable stars

Globular clusters The investigations of globular clusters that I have carried out in the past years have been founded mainly on photographs with the large reflectors at Mount Wilson Great telescopic power was necessary to separate and record adequately the exceedingly faint and concentrated individual stars An important study of the clusters has, however, just been completed with two miniature Harvard telescopes of two inches aperture—a research that would be quite impossible for the large reflectors This new work is the determination on a uniform basis of the total light of each of the globular clusters as a whole, and forms one of the steps in determining their relative distances and their uniformity in dimensions and brightness For this work the individual stars of a cluster are not desired, as the integrated photographic effect can be most satisfactorily measured on plates made with such small telescopes that the images of the clusters are themselves starlike

To determine the integrated magnitudes of the ninety-five recognized globular clusters, Miss Sawyer has handled hundreds of plates The study shows some variety among globular clusters, and also indicates that most of the typical systems are much alike in total absolute or intrinsic luminosity. They average 13.4 magnitudes intrinsically brighter than our Sun, and therefore each one radiates about 10^{39} ergs per second.

The brightest of the clusters are, of course, the nearest ones—ω Centauri and ξ Tucanae They are easy naked eye objects and are about ten magnitudes brighter photographically than the faintest These two leaders are far south, in fact, eighty per cent of the globular clusters are in the southern hemisphere, as are most good things (astronomically speaking) This simply means that the solar system is inconveniently located pretty far to the north of the center of the Galaxy

Iron and stone meteorites There are on record fifteen times as many falls of meteoric stones as of meteoric irons or stony irons, according to a recent compilation by Miss Mussells, but the total weight of the irons is 2 5 times the total weight of the stones. This ratio of 2 5 may be taken as a measure, or at least as an intimation, of the relative frequency of iron and silicates in inter-planetary and interstellar space, it can be compared with the ratio of iron to stone in the Earth, which Dr Fisher estimates at 4 5 Only the actual "falls" of meteorites are used in determining the ratio, for, once on the Earth's surface, irons persist but stones rapidly disintegrate, making estimates based on "finds" of meteorites of no significance for this computation

The total number of recorded falls during the last four centuries, up to the year 1923, is 438 The total number of finds, where the actual fall was not observed, is 411 The total weight of all known falls and finds is some two hundred and fifty tons, a ridiculously small figure compared with the mass of the Earth, which is about 6×10^{21} tons

New class O stars There is a particular interest and usefulness in finding and investigating the superlatives—the hottest or smallest or most distant or most something-or-other It gives us an idea of the extremes of nature and of the scope of our problems Likewise we seek to add new members to any rare or unusual class of objects in order to provide sounder data for statistical examinations

The Class O spectrum appears to be a peculiar stage in the life history of very massive stars Emission and absorption lines are there variously presented, and conditions of high excitation are indicated The O's have been placed at the top of the temperature scale—perhaps erroneously—and the spectroscopists are not yet in altogether happy accord in matters relating to their classification and to their joining up with the B-A-F, etc, series of more normal and numerously represented spectral classes. We shall have more luck with more data in hand.

To the 140 already known, Miss Payne, in a current publication, adds ten new stars of Class O, two of which are naked eye objects. All are in the southern hemisphere, and of course they lie close along the galactic circle, as do practically all stars of high intrinsic luminosity These new members of the class have already brought up the question as to the proper limits between the late O stars and the early B's

Beta Doradus The discovery of a naked eye variable star with a large amplitude of light variation is certainly unexpected at the present time, for the sky has been studied thoroughly for decades by variable star observers and has been photographed hundreds of times The far southern star β Doradus, however, not only varies in a ten-day period throughout more than a magnitude, but its variation is of the Cepheid type, for which the light is never constant A fourth magnitude Cepheid, such as this, is important because of the scarcity of bright Cepheids and also because these variables in general are the most useful stars in the sky They afford a powerful means of measuring great distances, and since their variations are not restricted to light alone, but affect color, velocity, spectrum and size, they bear on evolutionary problems The Cepheids are exceedingly large—supergiants, we call them And this one is a thousand times as bright as the Sun

The discovery and measurement by Shapley and Miss Walton of the variability of β Doradus on Harvard plates was brought about by reports on spectroscopic researches at the Lick Observatory, most recently by Miss Applegate

The Lick Observatory, using plates made in Chile, showed that in spectroscopic behavior the star is allied to the Cepheids, the Harvard observers, using plates made in Peru, showed that the star is itself a Cepheid The photographs that best show the variability are a special series of short exposures on the near-by Nova Pictoris The brightness of β Doradus had helped to conceal its variation heretofore, for on the usual photographs its images are overdone and so smeared that magnitude estimates are unreliable

Now that the variability has been found and its period is known, we turn to the old star catalogues and find that the early visual observations had hidden in them the proof of the variability The conservative astronomers of the past, however, had taken the blame on themselves for the large deviations shown by their measures, instead of mistrusting the star.

Only two or three Cepheids are brighter than β Doradus. The type star of the class, δ Cephei, is one, and the North Pole star is another, but its variation is less than a tenth the amplitude of that of our new southern Cepheid

Eclipse of the Moon. The lunar eclipse of June 15

was probably the best observed eclipse of the Moon in the history of science. It also brought about the highest degree yet attained in the cooperation of state, church, commerce and science in a single scientific problem. The Canadian and the United States Weather Services, the United States Army Signal Corps, the Roman Catholic Eskimo Mission, the fur traders and trappers along the Arctic Circle, the Royal Canadian Mounted Police, the powerful radio broadcasting stations of the Westinghouse Company, the astronomers of the observatories in western and southwestern America, the newspapers and Science Service, and the amateur astronomical observers over a large part of the United States were all involved in various phases of the meteorological and astronomical observations of this eclipse

It will be many months before all reports come out of Alaska and from the Canadian Arctic giving information concerning the character of the atmosphere where the grazing solar rays passed and were refracted into the Earth's shadow cone to illuminate faintly, and discolor, the eclipsed Moon

The general plans for the eclipse observations were developed by Dr W J. Fisher, of the Harvard staff, who has specialized in phenomena associated with lunar eclipses, the Canadian work was organized through the efficient cooperation of Dr R. M. Stewart, director of the Dominion Observatory at Ottawa

Nova in Magellanic Cloud. A nova in one of the Clouds of Magellan is of more than passing interest In the first place, such an object has not heretofore been found in either of the Magellanic Clouds, notwithstanding the presence there of practically all other known types of high luminosity stars In the second place, the distance of the Clouds are known, and therefore the actual luminosities of novae in such places can be computed, which is far from being the case for the nearer novae in our own Milky Way

While comparing two photographs of the Large Cloud, in a study of stellar motions, Dr. Luyten recently noticed on a plate taken last September a star that was wholly absent from all of the many earlier plates A search showed its images on eight other plates taken between September 28 and November 6 Just after this last plate was taken the Arequipa telescopes were dismantled for transfer to the new station in South Africa, and the further behavior of the star is unknown.

A cablegram to the South African observatories has resulted in some special photographs being made at the Union Observatory, Johannesburg, but the nova has apparently already disappeared At maximum brightness the star was difficult enough, being photographically of the twelfth magnitude. But actually, if it is a member of the Magellanic Cloud, it was, when brightest, some ten thousand times as bright as the Sun; the distance accounts for the apparent faintness. And while we are speaking of actualities we should add that it was only the terrestrial recording of a nova that occurred last September—the actual disaster happened nearly a thousand centuries ago

HARLOW SHAPLEY

SPECIAL ARTICLES

FURTHER STUDIES ON THE ANTIRACHITIC ACTIVATION OF SUBSTANCES BY CATHODE RAYS[1]

IN a previous preliminary report[2] it was shown that, with the exposures used, high-voltage cathode rays[3] applied directly were not effective in healing rickets in rats On the other hand, it was shown that cholesterol could be endowed with antirachitic potency by exposure to the cathode rays. In our earlier attempt cholesterol was exposed to the cathode rays in a rather thick film and had to be added to the diet in amounts of 0 2 per cent. or more to bring about within two weeks complete healing of rickets in rats, which were rendered antirachitic by the Steenbock rachitic diet No 2965.[4]

We have since found that, with the film of the substance about a millimeter or less, just as active products are formed by exposure to cathode rays as with ultraviolet irradiation and moreover the time interval is much shorter In Tables I and II are summarised some of the recent experiments carried out. The cathode ray exposure was in all cases at a distance of 1 inch from the window of the tube and a current of 1 milliampere and 200,000 volts used. The substances were exposed in air and in one instance in an atmosphere of nitrogen The cholesterol used in these experiments was a commercially pure product. In the experiments with cholesterol purified by the dibromide method, it was first brominated, then debrominated, brominated a second time, again debrominated and finally recrystallized three times from hot alcohol

From an examination of Table I it is seen that cholesterol exposed to cathode rays for 30 seconds is ef-

[1] From the Laboratory of Biological Chemistry, Albany Medical College, and Research Laboratory, General Electric Company, Schenectady, N. Y The writer is greatly indebted to Dr. W. D Coolidge for his valuable advice and assistance, and for the technical assistance of F. S Randles and H. E Tanis, Jr.

[2] Knudson, Arthur, and Coolidge, W. D, *Proc. Soc. Exp. Biol and Med*, 1927, XXIV, 363

[3] Coolidge, W. D., *Jour. Franklin Institute*, 1926, ccii, 693.

[4] Steenbock, H, and Black, A., *Jour. Biol. Chem*, 1925, lxiv, 263.

TABLE I

Effect of Cathode Ray Exposure on Antirachitic Activity of Cholesterol

No of rats	Experimental period, days	Test material	Length of exposure	Amount in diet or daily dose	Results shown by radio graphic examination
			seconds		
2	14	Cholesterol, commercial	30	0 05%	Moderate healing
2	14	"	0	0.3 %	No healing
2	14	"	30	0 25%	Moderate
2	14	"	30	0 25%	Beginning
*2	14	"	30 in N	0 25%	Beginning to moderate
2	14	"	30	0 01%	Beginning to moderate
2	14	"	900	0 03%	Moderate
2	14	"	30	1 mg daily	Beginning
1	14	"	30	2 mg daily	None
1	14	"	30	2 mg daily	Advanced
**2	14	"	U V 30 min	2 mg daily	Advanced
2	14	Cholesterol, purified by dibromide method	30	2 mg daily	No healing
1	14	"	30	4 mg. daily	"
2	14	"	30	0.05%	"
**2	14	"	U V 30 min	2 mg daily	"

fective in bringing about healing of rickets in doses of 1 or 2 mg per day. Exposure for as long as 900 seconds does not destroy the antirachitic potency It is also seen that cholesterol purified by the dibromide method can not be rendered antirachitic by either cathode ray exposure or ultraviolet radiation This result confirms those of Hess and Windaus,[5] and Rosenheim and Webster,[6] who were unable by ultraviolet radiation to activate cholesterol when thus purified.

* Cathode ray exposure in atmosphere of nitrogen

** Ultraviolet radiation with Victor Mercury vapor lamp for 30 minutes at a distance of 1 foot.

[5] Hess, A. F., and Windaus, H , *Proc. Soc. Exp. Biol and Med.*, 1926, XXIV, 171.

[6] Rosenheim, O., and Webster, T. A., *Jour. Soc. Chem Ind.*, 1926, 45, 932.

TABLE II

Effect of Cathode Ray Exposure on the Antirachitic Activity of Inert Substances

No. of rats	Experimental period, days	Test material	Length of exposure	Amount in diet or daily dose	Results shown by radio-graphic examination
			seconds		
2	14	Dry brewers' yeast, Harris	30	25 mg daily	Complete healing
2	14	"	0	25 mg daily	No healing
2	14	Special dry yeast, Fleischmann	30	10 mg daily	Complete
2	14	Dry brewers' yeast, Harris	30	5 mg daily	"
2	14	"	30	1 mg daily	Advanced
1	14	"	30	2 mg daily	"
2	14	Special dry yeast, Fleischmann previously extracted one week with ether	30	10 mg daily	"
*2	14	Corn-starch	30	6 per cent	None
2	14	Cottonseed oil	90	0 1 cc daily	Moderate
2	14	" "	0	0 1 cc daily	No healing

In Table II, it is seen that yeast, starch and cottonseed oil can also be activated by exposure to cathode rays The experiments with yeast are extremely interesting Yeast which contains ergosterol, considered to be the provitamin of vitamin D,[7] is rendered very potent by exposure to cathode rays With an exposure of 30 seconds, a dose of 1 mg daily brings about advanced healing of rickets within two weeks Compared with a good grade of cod liver oil this is at least 10 to 20 times more potent It is also interesting to note that a yeast which had been extracted previously for one week with ether in a continuous Soxhlet type of apparatus was still rendered very potent, indicating that the substance which is

* The line test showed beginning healing and the cornstarch in this case was exposed in rather thicker film than usual

[7] Rosenheim, O., and Webster, T. A., *Biochem. Jour.*, 1927, XXI, 389.

rendered antirachitic is not readily extracted with ether

ARTHUR KNUDSON

ALBANY MEDICAL COLLEGE,
ALBANY, N Y

THE DEVELOPMENT OF MORE EFFECTIVE DUST FUNGICIDES BY ADDING OXIDIZING AGENTS TO SULPHUR

SUGAR-CANE fields in Hawaii can not be treated effectively with liquid fungicidal sprays, because the matted cane growth prevents passage of men or work animals through a field For this reason we have attempted the use of fungicidal dusts which can be applied to the cane from the edges of the fields by motor-driven dusting machines or by airplanes

The problem we are working with is a serious infectious leaf and top disease of the cane, called eye spot, caused by the fungus *Helminthosporium sacchari* Butler Our first attempts against this disease were ineffectual, not from any difficulty in placing the dust on the cane but because the fungicidal dusts used caused little or no reduction of the disease In field-plot tests with adequate replications Bordeaux dust, and other copper mixtures, organic-mercury mixtures, sulphur mixtures, chlorine mixtures and coal-tar disinfectants gave little or no control of the disease The best result in these earlier attempts was in plots treated with ordinary dusting sulphur in which we obtained 27 per cent less infection than in alternating untreated plots which served as controls This reduction of the disease was not sufficient to recommend for plantation practice but was sufficient to encourage us to seek further for more effective compounds

Previous research by Young[1] showed that the fungicidal action of sulphur was due to the formation of pentathionic acid formed by oxidation in the air Young went further with this and secured greater fungicidal action by using more finely divided sulphur which would adhere to foliage better and oxidize more readily Young's conclusions have been questioned in England,[2] however

The slight reduction of our disease with dusting sulphur nevertheless led us to follow up Young's work, instead of depending upon the oxidizing effect of the air, such oxidizing agents as nitric acid, one fourth of one per cent, and pulverized potassium permanganate, 1 per cent, were added to the sulphur Seven plots of cane treated with the latter mixture have shown a reduction of 89 9 per cent. of infections as compared with seven undusted plots as controls, at the same time finely divided sulphur on seven plots has reduced the number of infections but 9 per cent Sulphur plus one fourth of one per cent. nitric acid in eight similar plots reduced the disease 61 per cent We have since increased the effectiveness of the oxidized sulphur even further by increasing the concentration of potassium permanganate to 5 per cent No burning of sugar-cane foliage resulted, even when the concentration of potassium permanganate was increased to 10 per cent

Potassium permanganate in a non-sulphur carrier such as kaolin has not reduced the disease as compared to untreated cane in control plots, indicating that the fungicidal effect is not due to the direct effect of the permanganate as a disinfectant but to its oxidizing effect on the sulphur.

It is possible to get quantitative data on the results of our treatments by marking an equal number of cane stalks in each plot and having counts of infections per leaf made at two-week intervals. The figures given above are from 140 leaf counts per treatment

At the same time that our oxidized sulphur preparations gave a good control of the disease, we received a stimulation of growth, apparently independent of the disease-control, as shown by growth measurements of 70 cane stalks per treatment The total increased growth was 8 8 inches per stalk, which would mean from two thirds to three fourths ton of sugar more per acre, a very profitable increase in yield.

It is our impression that dust fungicides against plant diseases have generally been less effective than liquid fungicides and that some of the sales of fungicide dust mixtures have been made by high-pressure salesmanship rather than on the basis of proven results in the field We believe that our oxidized-sulphur mixtures will place fungicidal dusts more nearly on a competitive basis with liquid sprays, with the added advantage of greater economy of application Care must be taken to keep these mixtures dry and away from fire, but millions of people have learned that gasoline can be used, with a few ordinary precautions

Concerning mixtures of oxidizing agents in sulphur as fungicides, a patent has been applied for and if any royalties do occur they will be applied for the furtherance of research.

H. ATHERTON LEE
J. P. MARTIN

EXPERIMENT STATION OF THE
HAWAIIAN SUGAR PLANTERS'
ASSOCIATION

[1] Young, Harry Curtis "The Toxic Property of Sulphur" Annals of the Missouri Botanical Garden, Vol IX, p 403, 1922

[2] The Association of Economic Botanists. Discussion on "The Fungicidal Action of Sulphur" Ordinary Meeting, Oct 20, 1925, *The Annals of Applied Biology*, Vol 13, No 2, p 308, May, 1926

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

RENO MEETING OF THE PACIFIC DIVISION

THE eleventh annual meeting of the Pacific Division held at Reno, Nevada, June 22 to 24, 1927, was generally conceded to be a very successful one, especially from the viewpoint of the visiting scientists That nearly 200 could be gathered together at a point so remote from population centers was considered a notable achievement. Credit is due President Walter E Clark and his very efficient committee on arrangements, under the chairmanship of Professor Maxwell Adams, for the harmonious functioning of the various programs

The outstanding event of the general sessions was undoubtedly the address of President Arthur A. Noyes on "The Periodic Relations of the Elements" This occurred on Wednesday evening, June 22, when after a charmingly cordial welcome by President Clark, of the University of Nevada, and the acknowledgment on behalf of the executive committee by Vice-president Joel H Hildebrand, President Noyes launched into his theme

The progression and recurrence of chemical and physical properties with increasing atomic number was considered in relation to the knowledge of the structure of atoms as developed within the past two years by spectroscopists and physicists

A novel feature of the lecture was the presentation of a large colored chart showing the energy-levels and quantum relations of the constituent electrons in the various neutral atoms and in the ions resulting from them by successive losses of electrons. By frequent references to this chart, it was shown in general that these modern conceptions of atomic structure correspond to the well-known periodicity of properties; and in particular the extent was indicated to which these conceptions account for such properties as valence, ion-formation in crystals and solutions, and the radii of neutral atoms and of the ions in the solid states.

It is hoped that this address may be published for the benefit of members who were unable to attend the meeting as well as for the information of the interested public.

The Research Conference scheduled for the luncheon period of the second day was accorded more time than at previous meetings and embraced reports of recent achievements in research in Pacific Coast labo-

ratories. Each speaker briefly presented notable results in his field, the whole forming a fairly comprehensive view of scientific activities during the past year. In this way, Dr Walter S Adams, of the Mount Wilson Observatory, treated the subject of astronomy, Dr. Leonard B Loeb, of the University of California, physics, Dr R E Swain, of Stanford University, chemistry, Dr. Charles B Lipman, of the University of California, botany, Dr C V Taylor, of Stanford University, zoology, and Dr P J Hanzlik, of Stanford University, medicine

This method of presenting at one meeting a general review of the whole field of science met with great favor It was felt that these research announcements must henceforth form a regular feature of the annual meeting Such a "clearing house" in the hands of leading specialists should prove of great value in acquainting the scientist with what is engaging the attention of his fellows and perhaps lead in some degree to coordination of effort. One delegate vouchsafed the opinion that such a session might well be adopted as a feature of the annual meeting of the parent association

A symposium on "The Scientific Problems of an Arid Region" was presented, with Gilbert Smith, professor of botany, Stanford University, Tracy I. Storer, associate professor of zoology, University of California, and J Claude Jones, professor of geology, University of Nevada, as participants

The address of Professor Henry H Dixon, of the University of Dublin, was of absorbing interest An abstract of Professor Dixon's paper on "The Nerves of Plants" follows.

From early times the cords of stringy tissue distributed through the parts of plants, especially through the leaves, have been called nerves The general resemblance of the distribution of these cords to that of nerves in man and animals is sufficient apology for the name.

Later, when it was found their minute structure was wholly different and that they discharged functions wholly unlike those performed by the nerves, their appellation was changed They were called veins—because they transmit fluids through the plant body, and, it may be noted, their peculiar structure allows these fluids to be dragged through them in a state of tension

At the same time observation and experiment clearly showed that plants are sensitive to external stimuli and that often these stimuli are transmitted considerable distances in a plant from the point of reception to the place where the response is manifested An outstanding example is furnished by the sensitive plant A touch on the leaf-tip of this plant will cause not only the leaflets of the tip touched to fold up, but even the leaf-stalk to bend downward and also, after a short time, similar changes in the other leaves of the plant. Here the stimulus is transmitted in the plant for many inches

The mystery of this was at first explained by adding it to the long debt already accumulated by the vital properties of the protoplasm—an admission of ignorance under the cloak of dogma: MacDougal in America and other investigators discredited this bill by showing that the stimulus is transmitted across dead tissues

Ricca in Italy confirmed these observations and showed that the stimulus liberated a soluble substance into the stretched fluid in the capillaries of the veins. This is instantly dragged through the veins to the responding tissues

It has also been shown that the stimuli of light, gravity and touch liberate *diffusible* substances in the tissues of other plants, and it seems certain that these substances are hurried in the same way through the wood *capillaries* to the point of response

Thus the swing of the pendulum of scientific opinion has brought us to regard the vascular bundles of plants, if not as nerves, at least as channels for conveying messages from the point of reception to that of response.

Such material messages conveyed in the moving fluids of the animal body are well known They are called "hormones"

With a total registration of 182 the attendance is hardly comparable with other meetings of the Pacific Division However, it is to be noted that the registration was composed almost exclusively of scientists geographically distributed as follows

Arizona	5
British Columbia	1
California, northern	81
California, southern	30
Colorado	2
Honolulu	1
Idaho	3
Ireland	1
Massachusetts	1
Minnesota	1
Mississippi	1
Nevada	25
New Mexico	1
Oregon	14
Philippine Islands	1
Quebec	1
Texas	1
Utah	6
Washington	3
Washington, D C.	2
Wisconsin	1
	182

Reports received from the secretaries of societies holding sessions at the Reno meeting are presented as follows:

American Association of Economic Entomologists, Pacific Slope Branch

(*Roy E. Campbell, secretary, Alhambra, Calif.*)

Although the attendance and number of papers were somewhat fewer than for several previous years, an excellent program was presented. Mr. F B Herbert told of a method of spraying for thrips which was almost as fast as dusting Professor H J Quayle's paper on "Spraying and Fumigating Combination for Control of Resistant Red Scale" brought out the fact that neither spraying nor fumigation alone is entirely satisfactory in controlling the resistant red scale of southern California districts, but that a combination is successful Moreover, fumigation following spraying is best, because the light oil-spray used loosens up the scales and forms a protective film on the foliage, so that the fumigation following kills the remaining live scales and does not injure the foliage. Professor Ralph H Smith's paper on "Investigations and Arsenical Residue on Apples" showed that lead arsenate alone sprayed on small apples is soon sloughed off, but when used with a spreader remains on the constantly enlarging apple for a long time. Also there is a decided increase in the amount of arsenic on the apples after each spraying, which gradually decreases up to the time of the next application.

In the symposium held jointly with the Pacific Coast Entomological Society on the topic "Arousing Public Interest in Entomology," Roy E Campbell mentioned some of the reasons for a greater public interest. Professor R. W. Doane's paper showed the importance of a more general knowledge of insects and disease in order to keep from becoming infected and also prevent insects from spreading disease. Mr W. C Jacobsen told how a more general knowledge of insects and an appreciation of their importance would help the quarantine officers in their efforts to prevent the introduction of injurious pests. Probably the most interesting paper on this topic was Mr. B C. Cain's, on his work among Boy Scouts. The boys show a tremendous interest in nature, and the insects, with their variety of forms and colors, diversity in habits and their marvelous interrelationships, present a wonderful field for out-of-door study.

Dr. S. B Freeborn's paper on "Efficient and Practical Control of House Flies" brought out the fact that several "fly sprays" were effective in keeping flies off of dairy cattle, but that their use actually reduced the production of milk, because of an accompanying rise in temperature and respiration in cows on which the material had been sprayed. Professor Doane in his paper on "Difficulties of Mosquito Control" showed that although mosquito abatement districts might clean up all the breeding places they were still subject to an occasional infestation due to mosquitoes being carried in by the wind from outside the district Cooperation of all affected districts was the remedy suggested Mr. S J. Snow's paper on "Effect of Ovulation on Seasonal History of the Alfalfa Weevil" showed that beetles remained immature until fall or longer of their first season, and that eggs and larvæ found in the summer are retarded members of the old overwintering generation and not a partial new brood

In Mr. Walter Carter's paper on "Isolation of Certain Yeasts and Allied Forms from *Eutettix tenellus*" the most interesting point was the mention of a new method of feeding sucking insects by the utilization of an animal membrane filled with the plant juices This offers an artificial method of feeding sucking insects which has many advantages over the old method of using live plants, twigs or leaves

Officers elected for the ensuing year are *Chairman,* R S Woglum, *Vice-chairman,* Geo M List, *Secretary-Treasurer,* Roy E Campbell

The American Chemical Society

(*Geo. W Sears, secretary pro tem.*)

Western sections of the American Chemical Society united in a regional meeting as a section of the Pacific Division. Two sessions were held during which nineteen papers were presented by members from Washington, Oregon, California and Nevada

"Essential Oils from Some Desert Plants" was discussed by Maxwell Adams An unusually large proportion of desert plants contain volatile oils and many of the plants now cultivated for essential oils are natives of arid regions Twelve varieties of plants were examined and the essential oils extracted by steam distillation and the physical constants of three were discussed at length

"The Oxidation of Sulfides in Alkaline Solution," presented by Ludwig Rosenstein, brought the fact that sulfides in solutions whose sulfide-ion concentration is determined by the presence of carbonates and bicarbonates are rapidly oxidized by air in the presence of small amounts of nickel or cobalt sulfide catalyst. Sulfur is the principal reaction product, though thiosulfate and tetrathionate are also formed. The process has been applied to gas purification and has resulted in the production of an amorphous wettable sulfur useful for agricultural sprays

"The Electrolytic Reduction of Sodium Nitrate," by H. K. Benson and J L Hoard, was presented by Dr. Benson When sodium nitrate is electrolyzed fumes of NO_2 and NH_3 are evolved Investigation of the nature and conditions affecting the reaction

brought out the fact that mercury was the most suitable cathode The proportion of ammonia produced depends largely on the condition of the electrodes. With bright electrodes the reduction to ammonia was found to be very small, while tarnished electrodes gave nearly complete reduction to ammonia. Large scale operation showed 80 per cent reduction to ammonia with 70 per cent current efficiency In discussing "The Carbonization of Sawmill Waste," by H. K Benson and W L Beuschlein, Dr Benson showed that sawdust could be converted almost quantitatively to charcoal in a rotary kiln, making use of a counter current air supply just sufficient to burn a fine-grained charcoal not spontaneously combustible

"The Commercial Production of Port Orford Cedar Wood Oil," by Floyd E Rowland, and the "Analysis of Port Orford Cedar Wood Oil," by P H Thurber, were presented by Mr Thurber Analysis showed 46 per cent. alpha pinene, 3 per cent. limonene, 26 per cent borneol, 21 per cent cadinene and 4 per cent cadinol The alpha pinene gave an optical rotation of + 53, which is much higher than the alpha pinene found in turpentine Since there should be four alpha pinenes it was thought this was a different one from that found in turpentine Since the oil proved to be different from the eastern product its commercial production will probably depend on extraction and utilization of the different components

In discussing "The Mechanism of Light Rotation by the Asymmetric Carbon Atom," H G Tanner pictured a mechanical atom in which the asymmetry was caused by the forces holding the different groups rather than by the groups themselves This conclusion was drawn from experiments with a mechanical model arranged to demonstrate the effect of polarized light

"The Determination of Tantalum and Columbium," by Geo W Sears, presented the results of an attempt to apply the principles found in a previous investigation to be effective for separating the two elements to their quantitative determination When an ore of tantalum and columbium is fused with sodium pyrosulfate at a temperature of 835–875° C the tantalum is rendered insoluble in concentrated sulfuric acid, while the columbium remains soluble If the fusion is made at a low temperature (about 600° C) interfering elements can be removed by solution in hot 3N hydrochloric acid without dissolving any of the tantalum or columbium and the combined tantalum and columbium may be determined by igniting and weighing the residue obtained By fusing this residue with sodium pyrosulfate and raising and holding the temperature at 835–850° C for 12–15 minutes the tantalum is rendered insoluble in concentrated sulfuric acid.

"The Reactivity of the Fused Alkali Amides," by F. W. Bergstrom and W. C. Fernelius, illustrated the similarity between reactions in liquid ammonia and water solutions. Both the strongly electropositive and strongly electronegative elements react readily with fused potassium or sodium amide, while the elements of intermediate electroaffinity, such as nickel, copper and iron, exhibit little or no action

In his discussion of "Low Students in Chemistry," R. A. Osborn showed that three fourths of the conditioned students, if given a review course, pass, although they remain poor students in the next course It was a question, therefore, whether they should not have been required to repeat the course in class

"Emulsification of Solid Powders," by J H Hildebrand, A J. Scarlett and W. L. Morgan, extended to solid powders, such as lampblack and manganese dioxide, the work of Hildebrand, Draper and Finkle, who had shown, in the case of benzene-water emulsions, that the type of emulsion and its stability may be controlled by using different metallic salts of the fatty acids

In discussing "Quantitative Treatment of Deviations from Raoult's Law," J H. Hildebrand stated that in the opinion of many authorities, Raoult's law provides a better starting point for the development of systematic thermodynamic treatment of solutions than does Van't Hoff's classic law of osmotic pressure. In its simple form it applies to very few systems and the departures in many cases are too great to be brought into order by the modifications of Raoult's equation It has been found possible to introduce an exponential factor, involving the gas content, absolute temperature and a specific constant for each system, into the ordinary equation of Raoult, which not only applies to all the regular systems (those which obey Raoult's simple law over some small range of concentration) but enables the solubility of one substance in another to be calculated at all temperatures if it is known for one temperature.

"A Laboratory Study of Nitrogen Fixation by the High Tension Arc," by H. V Tarter and P G Cohen, "The Occurrence of Hydrogen Sulfide in the Lake Washington Ship Canal," by E. V. Smith and T. G Thompson; "The Acidity of Waters of Some Puget Sound Bogs," by T G Thompson, J R Lorah and G. B. Rigg; "Improved Apparatus for the Removal of Dissolved Gases from Water," by J. R. Lorah and T. G. Thompson, and "Dissolved Gases in the Waters of Some Puget Sound Bogs," by G. B. Rigg, T G. Thompson, J R. Lorah and K. T. Williams, were briefly reviewed by Dr. Benson, who pointed out in connection with the first that the mass law holds approximately in the fixation of atmospheric nitrogen by means of the high tension arc and

that immediate cooling after passage through the arc is unnecessary

Three papers were presented by E. C. Gilbert as follows. "The Freezing Point-composition Curves for the System Acetanilide-Propionanilide"—in the neighborhood of the eutectic an unstable compound is indicated by the flatness of the curve in that region, "Some Observations on an Arsenic Trisulfide Alcohol" showed that the coagulating power of ions of different valence obeyed the same general rule as in water, though the concentration necessary for precipitation was less than in water, "The Surface Tension of some Long Chain Fatty Acids in a Heavy Hydrocarbon Oil"—the surface tension as determined indicated that neither the hydrocarbon chain nor the acid radical of the fatty acid extended uniformly into the oil at the interface, but that many of the acid molecules must extend lengthwise along the surface of the oil

At a dinner following the sessions, preliminary steps were taken toward the organization of the western sections of the American Chemical Society for the purpose of facilitating the arrangement of programs for regional meetings held in conjunction with the annual meetings of the Pacific Division of the American Association for the Advancement of Science

AMERICAN PHYSICAL SOCIETY

(*D. L Webster, Stanford University, California, local secretary for the Pacific Coast*)

The American Physical Society held two sessions, one a joint session with the Astronomical Society of the Pacific As in most of the current meetings interest centered chiefly on spectroscopy and its application to problems of the structures of molecules and atoms, on the one hand, and stars, on the other The aspects of molecular and atomic problems discussed at this meeting covered the whole range of such problems There were, for example, the paper of Gibson and Ramsperger on the slow vibrations of atoms in the ICl molecule, that of King on the lines due to the valence electrons of the cerium atom, and those of Allison and Webster on the behavior of the innermost electrons in the atoms as deduced from intensity measurements by X-rays In stellar applications of spectroscopy, interest centered on evidence from the sun, especially St John's very careful and important revision of the solar spectrum tables.

In fields other than spectroscopic there were papers on a great variety of subjects, among which may be mentioned especially the work of Loeb and Du Sault, establishing the monomolecular character of the ions in acetylene, and the evidence presented by Brinsmade for the remarkable extent to which electrons may be reflected from metals without loss of speed.

ASTRONOMICAL SOCIETY OF THE PACIFIC

(*Robert G. Aitken, secretary pro tem, Lick Observatory*)

The Astronomical Society of the Pacific joined with the Pacific Division and held a very successful meeting. Members of the society from Stanford University, the University of Nevada, the Lick, Howell, Mount Wilson and Students' Observatories and from San Francisco were present, and the attendance of the two sessions for the presentation of scientific papers, held on Thursday, June 23, averaged 25. The 26 papers presented, as is evident from the program, covered a wide range, the sun and the major and minor planets and comets and satellites of the solar system coming in for discussion, as well as variable and binary stars, very cool stars (cool only by comparison with average stellar temperatures), and giant M stars Practical astronomy was represented by papers on longitude determinations, on a horizon finding card and on a working model of an instrument for determining geographical points on the Sumner line at sea Of special interest were E. C Slipher's papers on the Lowell Observatory observations of Mars, Merrill's paper on a search for very cool stars, the paper by Adams and Joy on the relationship of spectral type to period among variable stars, Leuschner's report on the research surveys of minor planets, and Miss Losh's paper on magnetic storms and solar activity

The Lowell Observatory has a long and honorable record in the study of conditions upon the planets of the solar system and Slipher's paper on Mars and also the one on Jupiter and Saturn showed that this study is being pursued with ever greater success by the application of modern methods of investigation Of particular interest was the evidence presented of seasonal changes in color on the surface of Mars—most easily explained as due to the growth and decay of vegetation; of the existence in the atmosphere of Mars of impermanent features (clouds?) of two distinct varieties, one showing strongly in photographs taken in violet light, but feebly in those taken by red light, the other having just the opposite characteristics—facts which had been clearly brought out also by Wright's observations at the Lick Observatory in 1924 and 1926, and the evidence in favor of an atmosphere of greater extent than had been generally accepted prior to Wright's work in 1924

Merrill finds that "the sequence of giant stars seems to terminate abruptly with a group of long-period variables of classes M6e to M8e, whose effec-

tive temperatures are slightly above 2,000° C at maximum." Stars cooler than this are not known, though present observational methods are apparently competent to reveal them if they exist "The fact that the coolest stars we know are all long-period variables may indicate a region of instability as the temperature approaches a limit set by some physical law"

In investigating the relationship of spectral type to period among variable stars, on the basis of a study of some 60 variables with the 100-inch telescope, Adams and Joy find, first, that "a large majority of the Cepheids, including all of the brightest and best known stars, show a very nearly linear relationship between spectral type and logarithm of the period" This relationship had been known before, in a general way, though no exact correlation had been established The "rather surprising result" of extending the investigation to the short-period cluster-type stars and the long-period red variables is that, "on the average, these two classes fall close to the curve derived from the Cepheids—The conclusion seems to be justified that the physical cause of the variation in light of these different classes of variable stars is similar and probably is to be ascribed to a periodic variation in size"

The paper by Leuschner and Thiele giving a progress report on the research surveys of minor planets was presented by the senior author and showed in striking manner how incomplete our knowledge of the minor planets still is Ordinarily, it is stated that between 1,100 and 1,200 of these bodies are known If every discovery is of a different object, the actual number of those that have been observed is more nearly 2,600, but the majority were so poorly or incompletely observed that they have been "lost"; even of those regarded as known only a small fraction have orbits sufficiently well determined to warrant the publication of observing ephemerides, and the number for which thorough orbital investigations are available is small indeed Cooperative research, under the auspices of the appropriate committee of the International Astronomical Union, is now in progress, and in this Professor Leuschner and his colleagues at the Students' Observatory are taking a leading part.

A magnetometer for recording the range in the horizontal component of the earth's magnetic field was installed at the Mount Wilson Observatory in August, 1926 Miss Losh has compared the records of magnetic storms with the observation of sunspot groups and other evidences of great solar activity and finds the usual close correlation For example, one of the largest complex sunspot groups of the year came round the east limb of the sun on September 12, 1926, a marked magnetic storm began on September 14 and continued until this group passed around the west limb. When the disturbed area on the sun reappeared, as the result of the solar rotation, a second and even greater magnetic storm occurred on the earth on October 13.

Space limits forbid further comment on these and the many other interesting papers presented. All the research observatories in the Pacific area, from Victoria to Flagstaff, have obviously had a successful year

Members of the society participated in the general sessions of the division on Wednesday and Thursday, Dr W S Adams, director of the Mount Wilson Observatory being one of the speakers at the "Research Announcements" luncheon on Thursday.

W W SARGEANT,
Secretary

(*To be continued*)

THE EMERGENCE OF THE BIOLOGY OF FOREST AND RANGE

THE rapid rise of interest in the biology of forest and range is an outstanding sign of the scientific times While it is true that during the past two or three decades a few writers have called pointed attention to certain phases of the problems involved, most silviculturists, biologists and range research men have overlooked them. Of necessity, since the many partial problems merge into one big bio-ecological unit, the union of biology and forestry must be something more than a companionate marriage It must be an old-fashioned and enduring alliance. The case is the same with biology and range research

PRESENT TRENDS

The emergence of the biology of forest and range is associated with a new interest in all phases of the environmental relations of organisms It is increasingly realized by biologists that these environmental relations are worthy of as close, consistent, prolonged, and quantitative attention as the phases of genetics and heredity which have been examined of late years with such illuminating and valuable results.

The following events may be cited as among those which seem to show a movement of interest and attention in the right direction·

The organization and activity of the Ecological Society of America, and the noteworthy success (at least along technical lines) of its official organ, *Ecology*.

Increased recognition by the United States Department of Agriculture, especially through the Bureaus of Biological Survey, Entomology, Plant Industry and the Forest Service, of the significance and im-

portance of forest and range biology. The work and writings of certain leaders among the scientists in and out of the department, including, among others, F. E. Clements, F. C. Craighead, E P Farrow, J Hoffmann, E A Goldman, J. Grinnell, C F Korstian, Aldo Leopold, W. L McAtee, E. N Munns, Edward W. Nelson, G. A. Pearson, V. E. Shelford, J W Toumey, I Traghardh

The publication of Jennings' "Prometheus"

The contributions of the Roosevelt Wild Life Forest Experiment Station, Syracuse University, New York, under the direction of its former head, Chas C Adams, and his associates

The activities of the President's Conference on Outdoor Recreation

The outstanding work of the special committee on forest research of the Washington Section of the Society of American Foresters, which resulted in the publication of "A National Program of Forest Research" (American Tree Association, November, 1926, by E H Clapp) This is unquestionably the most valuable survey of the field of forest research that has been made in this country to date The biological side of forestry is clearly outlined, although the biological features of range research do not seem to have been so clearly appreciated

The introduction, March 3, 1927, in the Sixty-ninth Congress, of the McSweeney Bill, providing for a more adequate forest and range research program in the United States Department of Agriculture

The appointment of Paul G. Redington, formerly of the Forest Service, United States Department of Agriculture, as chief of the Bureau of Biological Survey.

The success of and obvious interest in the symposium on "The Forest and Forage Crops in the Southwest," held at the meeting of the Southwestern Division, American Association for the Advancement of Science, Santa Fé, New Mexico, April 13, 1927 Different aspects of the biology of forest and forage production were stressed by several of the speakers.

FOREST PATHOLOGY

The important effects of parasitic plants and of wood-rotting fungi in relation to the maintenance and administration of the forest have been obvious for a considerable period to the experts of the Bureau of Plant Industry, the New York Botanical Garden, the Forest Service and a few other agencies. Indeed, forest pathology may be regarded as a relatively early emergent in the province of the biology of the forest. One has only to recall the importance of such studies as those on the chestnut blight and white pine blister rust to recognise and appreciate the far-reaching, continuing and increasing significance of forest pathology The names of Robert Hartig, of Germany, father of plant pathology, and his disciple, F W Neger, and of the following American workers come to mind among those who have made notable contributions E P Meinecke, W. H. Long, J R. Wier, R C Colley, F. D Heald. While *forest* pathology has developed to a considerable extent, *forage* pathology, undoubtedly an important field, has apparently received little attention

On the whole there has been a much clearer appreciation of the plant side of forest biology—as in the development of forest pathology—than of the animal side It is to the animal side of the biology of forest and range, therefore, that the chief attention is here addressed.

THE PROTECTION OF FOREST AND FORAGE FROM ANIMAL PESTS

Far-sighted administrative officials, especially those on the ground, as well as progressive private users of range and of forest, have long been impressed with the damage done by animal pests The destructive effects of bark-beetles and other insects, and of certain rodents, as the porcupine, in the woods, and of such animals as the prairie-dog and jack-rabbit on the open range, have been obvious to many While this phase of animal relations to forest and range, referred to as "Protection," does not, even yet, receive sufficient consideration in many places, it does come nearer than any other to getting adequate attention. Indeed, it is often the only aspect of the zoology of forest and range receiving any notice at all

POSSIBLE BENEFICIAL ACTIVITIES OF ANIMALS ON FOREST AND RANGE LANDS

The beneficent rôle of insectivorous birds in farming districts has been emphasized by the thorough studies of the subject made by the Biological Survey This function of birds is widely recognized. That birds exercise a similarly beneficial service to forest trees, browse, and even forage grasses is sometimes not kept in mind Other possible benefits by animals include the cultivation of the soil of range and forest by earthworms and burrowing rodents, the caching and planting by birds and mammals of the seeds of trees and other plants with consequent assistance to the maintenance and even extension of the vegetation, the nitrifying of the soil through the wastes and remains of the animal body, the activity of predatory insects, amphibians, reptiles, birds and mammals in destroying various other species of insects, rodents, or other forms of animals that prey on

vegetation, the serving as food for game fishes or other valuable species

SOME BIO-ECOLOGICAL RELATIONS

Even moderate use by man of the timber and forage is almost sure to upset the balance between the plants and animals and their environment on forest and range lands Clear cutting, over-grazing and burning bring about profound and often catastrophic changes, involving not only the physical but also the biotic factors of site The removal of the plant-cover promotes destructive erosion, injures the watershed value of an area, affects for the worse the welfare of near-by farming sections and cities and often promotes disastrous floods As Jones has pointed out, "It was destructive erosion and not war that destroyed Assyria and Babylonia" ("Watershed Handbook," U S Forest Service, Southwestern District, December, 1923, mimeographed). Successful natural reproduction of forest, reforestation by either seeding or planting, maintenance of desirable forage cover, all depend on adequate attention to bio-ecological problems, as does also the effective protection of game mammals, birds and fishes

SOME GENERAL VALUES OF WILD LIFE

Edward W Nelson, T. S Palmer, Chas. C. Adams and others have pointed out the educational, recreational and financial value of wild life Adams's recent detailed study and demonstration ("Importance of Animals in Forestry," *Roosevelt Wild Life Bulletin*, Vol 3, no. 4, October, 1926) of the important place occupied by animals in the economics of the community is convincing and impressive It is believed that few technical men, not to mention state and even federal administrators, fully appreciate the value of wild life Adams very properly stresses the unity of the forest resources To realize fully on these resources they must be intelligently managed, with the object of making each area produce the largest contribution to the people's welfare, having regard to its varied products in forage, forest and wild life

CONCLUSIONS

Whereas, in most lines of agriculture over-production is so outstanding a phenomenon that curtailment is widely recommended by economists, precisely the opposite is the case in silviculture and forage production America's wild crop of timber and of feed for livestock falls far short of the demand Careful attention must be given to all the conditions surrounding the growth of these crops. Among the factors of major importance are the native animals of forest and range lands. Some are pests; others are beneficial Most play mixed rôles. Efficient production of trees and forage necessitates thorough-going study of the life histories and ecology of all the predominants, both plants and animals. Many animals, especially fishes, birds and mammals, are themselves of extraordinary value for recreation, study, and as a source of income. In some instances the value of the animals on a given area may exceed that of forage or trees The production of wild life should be more than an incident or by-product of forest and range management The objective should be maximum continuing values from each area Attainment of this objective necessitates additional information and increasingly enlightened administration Research is the foundation of our present prosperity It must be the corner-stone of future advance. "The application of traditional methods will no longer suffice" Biology must participate fully in the solution of the many problems involved

WALTER P TAYLOR

TUCSON, ARIZONA

SCIENTIFIC EVENTS

THE FIFTH INTERNATIONAL BOTANICAL CONGRESS

AT the International Congress of Plant Sciences (Fourth International Botanical Congress) held at Ithaca, New York, in August, 1926, an invitation was conveyed from British botanists for the Fifth International Botanical Congress to be held in England in 1930 The invitation was accepted by the botanists assembled at Ithaca, and arrangements are now being made for the congress to be held at Cambridge about the middle of August, 1930

An executive committee has been formed to make arrangements for the congress, consisting of Dr F F. Blackman, Professor V. H Blackman, Dr. E J Butler, Professor Sir John Farmer, Professor F E Fritsch, Professor Dame Helen Gwynne-Vaughan, Dr A. W Hill, Professor W Neilson Jones, Sir David Prain, Dr A B. Rendle (treasurer), Professor A C Seward (chairman), Professor W. Stiles and Professor A. G. Tansley.

It has been decided to organize the congress in the following seven sections Morphology (including Anatomy), Paleobotany, Plant Geography and Ecology, Taxonomy and Nomenclature, Genetics and Cytology, Physiology and Mycology and Plant Pathology.

Mr. F. T. Brooks, the Botany School, University of Cambridge, England, and Dr. T F. Chipp, Royal Botanic Gardens, Kew, England, have been appointed honorary secretaries of the congress, and any com-

munications with regard to it should be addressed to one or other of the secretaries.

THE ANTARCTIC EXPEDITION OF COMMANDER RICHARD E BYRD

The National Geographic Society has announced that it will cooperate in the Antarctic expedition, sending observers and contributing $25,000 toward equipment

The society has issued the following announcement in connection with the expedition

Conditions in striking contrast to those in the Arctic will be encountered by the Byrd expedition in the Antarctic Instead of a vast expanse of sea and relatively low land, there is a high continent larger than Australia or the United States

In the valleys of the Far North the summer sun brings moss, grass and flowers But, in contrast, the bleak plateaus and mountains of the Antarctic harbor practically no living things because much of their area is perpetually blanketed by snow and ice

Birds frequent the edge of the ice barrier where they can exist upon the creatures of the sea, but inland no life has been found because there is no vegetation

The bears, wolves, foxes, rabbits, musk oxen and caribou of the Far North have not a single representative in the Far South known to man

Commander Byrd's expedition will doubtless be able to augment the information contained upon the now meager maps of the Antarctic continent Explorers can not sail along the coasts of this continent as they can along those of Australia or Africa

The great ice barrier and pack ice keep ships at a distance, sometimes of several hundred miles Only in a few isolated places has this barrier been penetrated This condition is in contrast to that of Greenland, where the ice cap extends to the coast in only a few places

The present map of the Antarctic regions, therefore, is mostly blank, with a few patches of known territory along the coast and one or two narrow paths penetrating inland The best known region is the land directly south of New Zealand traversed by Shackleton, Scott and Amundsen

Among the important problems to be worked out by Commander Byrd are those relating to the meteorology of the southern continents and its effect on world weather, especially that of the southern hemisphere

Although the field for zoological research in the Antarctic is narrow, the party will be on the lookout for any specimens that may be encountered in regions hitherto unvisited by man Any rock specimens that give promise of adding to the geological knowledge of the unexplored continent will also be collected

WOOD COLLECTIONS OF THE FIELD MUSEUM

Work has been begun to make the wood collections at Field Museum of Natural History the most comprehensive and authoritative for scientific and economic reference purposes in the middle west

Additions to the exhibits, rearrangements of them and revision of the labels are planned, all designed not only to increase the interest of the collections to the general public, but to make them also of direct service to men in the lumber business, government forestry officials and others interested in conservation and reforestation, to students and scientists specializing in this branch of botany, and to every user of wood for building or manufacturing purposes

Professor Samuel J Record, of Yale University School of Forestry, who has spent seventeen years in specialized research on woods and wood products, has been engaged to supervise this work, and is now at the museum Professor Record, who has traveled widely in this country and abroad studying the various types of woods from the time of their growth in the forests through the various stages of logging and milling to their appearance as building materials or manufactured products, is the author of numerous volumes on this subject and editor of the magazine *Tropical Woods*

A number of leading companies in the lumber and woodworking industries have indicated to the museum that they will cooperate in the work being undertaken

Many woods from western states, some from the eastern states, and a large number from tropical and other foreign localities not heretofore included in the museum collections are to be added These exhibits, like those already on display, will contain specimens of the trunk and foliage of the various trees as they appear in life, photographs illustrating their growth, maps showing their distribution, typical boards and specimens of the other principal economic products manufactured from them, and monographs containing the most important data regarding their growth, their properties and their uses

Many lumber manufacturers and other users of wood are insufficiently acquainted with the various types of woods, and their uses, particularly the foreign woods At the present time the amount of foreign woods coming into our markets is constantly increasing, owing to depletion of our own forests, and it is highly important to know which of these foreign woods are suited for various purposes, and which are not As Chicago is the lumber center of the Middle West, the museum collections will be able to serve the entire industry in this region in adjusting itself to the new conditions which are appearing, and which will rapidly become more apparent in the near future. It is hoped that the museum's work may also furnish a contribution to the conservation and reforestation movements in this country, by supplying information which will advance these movements

THE UPPER MISSISSIPPI WILD LIFE AND GAME REFUGE

TEN million acres of land will be embraced in federal preserves for the protection of fish, fowl and game when the government acquires the upper Mississippi wild life and game refuge Regulations for the new preserve were signed jointly on June 24 by Secretary of Agriculture Jardine and Secretary of Commerce Hoover

Nor is the total of protected havens for wild fowl represented by the federal acreage, for almost every state has converted areas of its own into conservation projects, and hundreds of farmers have limited hunting expeditions on their property Figures from the United States Biological Survey, issued on July 1, according to a report issued by the Associated Press, show from 165,000 to 200,000 acres involved in the Mississippi wild fowl project, 36,000 acres of which already is under contract to the government at $5 an acre Most of the territory is meander land, unsuited to agricultural purposes, but a number of owners are asking as much as $26 an acre

Congress made available $3,000,000 to purchase the refuge Only about $300,000 of that sum has been used, and whether the next session will increase the latitude in price is a matter of pertinent importance Much of the higher-priced land lies in Illinois Wisconsin has supplied the bulk of the present federal possessions, Minnesota recently donated its entire Mississippi holdings and the rest of the refuge is on the Iowa side of the river

While federal regulations will predominate in the preserve, there is to be no conflict with state fish and game laws H P Sheldon, chief United States game warden, is pleased with the suggested Mid-West conservation code sponsored by the Illinois General Assembly Other states in the upper Mississippi Valley and the Great Lakes region are expected to join Illinois in adoption of uniform statutes

Such plans are desirable They add to conciseness and make conservation at once more practicable and more easily enforced. Our best example, according to Mr Sheldon, is the migratory game bird treaty with Great Britain, by which wild fowls are protected in this country and Canada on a reciprocity basis

Officials of the Biological Survey emphasize the benefit of uniformity in game laws

For thirty years this country has worked to replace local county laws with state and federal statutes North Carolina is the most recent state to come into the fold and now the laws of more than forty states conform to federal regulations There is no other satisfactory way to systematize open season for especially wild geese and ducks

Government authorities believe game to be increasing in the East It is maintaining a level in the Middle West, while the West itself, because of drainage projects and light rainfall, has suffered a decrease.

SIR WILLIAM THISELTON-DYER

ON July 28, Sir William Thiselton-Dyer reached the age of eighty-four years In referring to this anniversary, *Nature* writes "His many friends rejoice to offer affectionate tribute to one who has done so much to promote and extend the plant resources of the British Empire Nearly two years ago (September 26, 1925) we published an appreciative article upon Sir William's work at the Royal Botanic Gardens, Kew, and its influence upon both pure and economic botany, and we are glad to know that its importance is widely recognized He and Lady Thiselton-Dyer celebrated their golden wedding on June 23, and among the messages of congratulation were one from Mr L S Amery, secretary of state for the colonies, and another from Professor von Goebel, the doyen of German professors of botany Mr Amery referred appreciatively to Sir William's studies in the field of botanical enterprise, by which he has 'rendered such valuable services in all corners of the Empire,' and Professor von Goebel wrote 'It was you who first brought English and German botany into association which—serving as it does purely ideal aims—could not be destroyed by the war, and, further, we German botanists remember with gratitude the great services which you rendered with regard to Kew, with which in company with the two Hookers your name also will always be connected' It should be as encouraging to scientific workers generally as it is gratifying to Sir William Thiselton-Dyer to know that the seed of voluntary scientific service, such as was sown by him during many years, has borne rich fruits for the benefit of the human race, and that its value is understood in many lands"

SCIENTIFIC NOTES AND NEWS

PROFESSOR FRANK B MORRISON, assistant director of the Wisconsin State Agricultural Experiment Station, has been appointed director of the New York State Agricultural Experiment Station at Geneva, N. Y., by the trustees of Cornell University He succeeds Dr Roscoe W Thatcher, who resigned recently to accept the presidency of the Massachusetts Agricultural College

DR DAVID WHITE, who has been serving as chairman of the Division of Geology and Geography of the National Research Council for the past three years, has returned to his former position in the U S Geological Survey.

DR T WAYLAND VAUGHAN, director of the Scripps

Institution of Oceanography at La Jolla, Calif, has been appointed chairman of the committee on submarine configuration and oceanic circulation of the National Research Council and a member of the committees on features and changes of the shore line of the Pacific Coast, on quantitative data of geological processes, on sedimentation, on submarine topography and structural history of the Caribbean Gulf region and on the award of fellowships

THE Baly Medal of the Royal College of Physicians has been awarded to Dr A V Hill, since 1926 Foulerton research professor of the Royal Society The Moxon Medal of the college has been awarded to Sir Henry Head, the neurologist

M EMILE PERROT, professor of pharmacy in the University of Paris, has been elected a member of the Paris Academy of Medicine

SIR HUMPHRY ROLLESTON has been appointed by the Royal College of Physicians and Surgeons to deliver the Harveian oration in 1928, Dr G F Still, FitzPatrick lecturer for 1928, Dr J S Collier, Lumleian lecturer for 1928, Dr E P Poulton, as Oliver Sharpey lecturer for 1928, Dr H H Dale, as Croonian lecturer for 1929, and Dr T Izod Bennett, as Goulstonian lecturer for 1928

BY an order of the Committee of Privy Council, Sir Hugh K. Anderson, M D, F R S, master of Gonville and Caius College, Cambridge, and Professor T. R. Elliott, M D, F R S, director of the Medical Unit, University College Hospital, London, have been appointed members of the British Medical Research Council to fill the vacancies caused by the retirement of Sir Frederick Andrewes and Sir Cuthbert Wallace

W F JOACHIM, of the Langley Memorial Aeronautical Laboratory, has received the Rudolph Diesel prize for 1927, consisting of $100 with a certificate for his paper, "Oil Spray Investigations of the National Advisory Committee for Aeronautics," delivered at the Oil Power Week meeting, which took place in April at Pennsylvania State College

GEORGE ST J PERROT, of North Dakota, has been appointed superintendent of the Pittsburgh Experiment Station of the Bureau of Mines He succeeds Arno C Fieldner, who recently was promoted to the post of chief engineer of the Bureau of Experiment Stations

AT the Massachusetts Agricultural College at Amherst, Massachusetts, Dr Robert J. McFall, extension professor of agricultural economics, on leave of absence for work in cooperation with the U. S Department of Commerce, recently resigned to become special agent in the Bureau of Foreign and Domestic Commerce.

HENRY C WATERMAN, of the bureau of chemistry of the U S. Department of Agriculture, has been appointed associate chemist and will have charge of the abstracting for *The Experiment Station Record* in the sections of agricultural and biological chemistry and soils and fertilizers

DR F L KELLY, assistant professor of public health administration and lecturer in preventive medicine at the University of California, has been appointed to the position of director of public health for the city of Oakland

DR R W BALCOM, chemist in charge of the food control laboratory of the U S Department of Agriculture, and A S Mitchell, of the Food, Drug and Insecticide Administration, have been designated as members of the Food Standards Committee as two of the three representatives of the department on that committee Two vacant places existed on the committee by reason of the transfer of Dr W W Skinner and Dr F C Blanck to the research unit of the Bureau of Chemistry and Soils W S Frisbie, chemist in charge, office of cooperation of the Food, Drug and Insecticide Administration, is the third department representative on the committee

SURGEON-GENERAL HUGH S. CUMMING, Surgeon B J Lloyd and Surgeon J D Long have been designated to attend the eighth Pan-American Health Conference at Lima, Peru, on October 12 One purpose of the conference is to provide for closer cooperation in the study of the health problems of the Western Hemisphere

FRANCIS F LUCAS, in charge of micrographic work for the Bell Telephone Laboratories, sailed for Europe on August 20 Before the International Congress for Testing Materials at Amsterdam he will present a paper on some of the laboratories' recent pioneer work in magnification of 6,000 times and more, particularly with the aid of ultra-violet light While abroad he will confer with scientific men in the Zeiss Optical Works, who are collaborating with him in the development of instruments He will also visit leading European laboratories

DR C E SKINNER, assistant director of engineering of the Westinghouse Electrical Company, sailed on August 17 as a delegate to the International Electrotechnical Commission Convention, which will be held at Bellagio, on Lake Como, Italy, September 4 to 24. Dr. Skinner is chairman of the Delegation of Standard Voltages, chairman of the Delegation on Traction Motors, and is the U. S Representative of the Committee of Seven Nations of the proposed International Standards Association.

DR. FREDERICK G KRAUSS, professor of agronomy

and genetics in the University of Hawaii, has been given leave of absence for an extended study of tropical plants, especially the pineapple, in the Dutch East Indies and Malaya, and of Cajanus in the Himalayan region He will then proceed to Berlin for the Fifth International Congress of Genetics in September and a year's genetics study in Germany

DR LAURENCE H SNYDER, associate professor of zoology at North Carolina State College, has left for Europe to take part in a symposium on blood groups at the International Eugenics Congress in Amsterdam Before returning to the United States, Dr Snyder will visit the larger genetics laboratories of Europe

PROFESSOR JOHN W FREY, of the department of geology of the University of Wisconsin, and Loyal Durand, Milwaukee, assistant in geography, are visiting Europe to become familiar with the industrial geography of Southern Belgium, the Upper Silesia area, Leipzig, North Italy, South Wales and Scotland They will return about September 3.

PROFESSOR WILLIAM E HOFFMANN, head of the department of biology of Lingnan University (Canton, China), has been sent by that institution to the Philippine Islands, where he is to spend two months investigating insect problems common to South China and the Philippines

BY authority of the Cabinet permission has been granted to the American School of Archeology in Athens to carry out excavations on the site of ancient Athens The conditions provide for the sectional expropriation of the buildings on the site within five years The first section to be expropriated contains twenty-five buildings Professor Capps, the director of the school, is now in the United States to raise the necessary funds He hopes to return to Athens in October

PROFESSOR T SHINOSAKI, of the University of Tokyo, who has been in Germany for three years engaged in medical research for the Japanese government, is in the United States He plans to spend some time at the Mayo Institute, Rochester, Minnesota.

IT is proposed to collect funds for the establishment of a scholarship at Armstrong College, Newcastle-on-Tyne, in memory of Douglas A Gilchrist, professor of agriculture, who died on April 4

IT is planned to erect a monument at Lyons to the late Count Hilaire de Chardonnet, the "Father" of the artificial silk industry

DR BRUCE FINK, since 1906 professor of botany in Miami University, died suddenly on July 10, in his sixty-sixth year Dr Fink was an authority on lichens

DR THOMAS W. SALMON, medical director of the National Committee for Mental Hygiene and professor of psychiatry in Columbia University, was drowned while cruising in Long Island Sound on August 13 Dr Salmon was fifty-one years old

INFORMATION has reached this country that Professor Rudolf Magnus, professor of pharmacology in the University of Utrecht, who was to give the Lane lectures at the Stanford University School of Medicine, San Francisco, in April, 1928, died suddenly the latter part of July Professor Magnus intended to give five lectures under the general heading of "Contributions to Experimental Medicine and Pharmacology"

AT the invitation of the Government of the Union, the fifteenth session of the International Geological Congress will be held in South Africa in 1929, with Pretoria as its headquarters This invitation is the outcome of a strong desire expressed at the last congress in Madrid to hold the next meeting in South Africa.

PROVISIONAL arrangements for the seventh congress of the Far Eastern Association for Tropical Medicine, to be held in Calcutta in December, show that much attention is being paid to the subject in the United Provinces, where a strong committee has been formed to entertain and inform the delegates After a week of scientific sessions the congress will split up for tours, and one party of about 130 strong, including interpreters, will visit Benares, Lucknow, Delhi and Agra. Another party will visit the Kala Azar area in Assam.

THE permanent committee of the International Institute of Agriculture at Rome announces that applications will be received for the following appointments to the staff of the institute One "chef de section" (chief of section) specially qualified in tropical agriculture; five "redacteurs" to write for periodicals, specially qualified in tropical agriculture, in dairy science, in plant diseases, in rural economics and in the trade in agricultural products The minimum beginning salaries for the above positions are For the "chef de section," 35,800 liras per annum (approximately $2,000); for the "redacteur," 22,750 liras per annum (approximately $1,300). The traveling expenses (second class) of successful candidates will be repaid when they take up their posts Members of the staff living at a distance of more than 1,000 kilometers from Rome have a right to the payment once in three years of their traveling expenses to their countries The appointments will be made as a result of an examination of the qualifications of the candidates, in which account will also be taken of knowl-

edge of languages. Applications should be addressed to the Bureau du Personnel, Institut International d'Agriculture, Villa Borghese, Rome.

John D. Rockefeller, Jr, has given $60,000 a year for five years to the Memorial Hospital for laboratory and clinical research into the causes of cancer, the education of specialists who could diagnose cancer in its early stages and for improving and enlarging the nursing and medical staffs

One hundred seismological stations are being built throughout the Soviet Union by the Academy of Sciences, which is undertaking to forecast earthquakes in the hope of saving life and property Professor Nikiforoff is in charge of the work

Nature states that the Astronomer Royal has arranged for the supply of enlarged photographic prints of the fine picture of solar prominences and inner corona secured at Giggleswick during the total eclipse of the sun on July 29 The moon's disc on the picture is 7½ inches in diameter, and the structure of the prominences and corona is remarkably fine and clear on the print Copies may be purchased upon application to Mr F Jeffries, Royal Observatory, Greenwich, London, S E 10

The University of Leyden has held a special exhibition of the portraits and scientific instruments of Dutch physicians, biologists and instrument makers of the seventeenth and eighteenth centuries, in the physical laboratory of the university on the occasion of the sixth Congress of the History of Medicine, which was held in July, in Leyden and Amsterdam *Nature* states that Drs C A Crommelin, W P Jorissen, C J Van der Klaauw and W H Van Seters, have collaborated in producing a catalogue of the 139 objects exhibited in illustration of the work of 's Gravesande, the Munchenbroecks, Huygens, Leeuwenhoek and Swammerdam Two of the exhibits, two object glasses made by Constantijn Huygens, junior, and signed by him "C Huygens, 10 May 1686, Ped 122" and "C Huygens, 19 Jun 1686, Ped 84," are of great interest, because they are accurately dated documents which, taken in conjunction with the three object glasses in the possession of the Royal Society of London, and dated June 4, June 26, and July 23, 1686, are evidence of the great industry and rapidity of working of the maker We also note the reappearance of a quadrant made by J. M Kleman for Boerhaave for use at his country house at Oud-Poelgeest Although not stated in the catalogue, this quadrant, after being exhibited at Oxford in 1919, was given to the University of Leyden by the late Sir William Osler.

The annual report of the Rockefeller Foundation for 1926 shows the total amount available for disbursement was $15,818,156, of which $9,741,474 was disbursed on account of appropriations, leaving an undisbursed income on December 31, 1926, of $6,076,682 Against this were unpaid appropriations of $4,200,284, leaving a balance of $1,876,398 available for 1927 appropriations The income for 1926 was $9,075,022, which, with undisbursed income on hand January 1, 1926, and refunds during 1925 on prior year appropriations of $6,743,134, brought the total amount available for disbursement to the above figure Disbursements under the general budget in 1926 included $2,516,758 for the International Health Board, $1,412 109 for the China Medical oBard, $674,294 for the Division of Medical Education, $759,162 for the Division of Studies, and $152,737 for the Central Administration, while capital expenditures were $1,567,688 for the International Health Board, $61,164 for the China Medical Board, and $2,597,652 for the Division of Medical Education The total assets of the foundation on December 31, 1926, were $180,397,799, including undisbursed income of $6,076,682 The book value of the principal fund was $165,204,624, to which $77,000 was transferred in 1926 from the special fund Land, buildings and equipment at the end of 1926 were valued at $9,039,493, of which $8,991,753 were abroad and $47,740 in New York offices

UNIVERSITY AND EDUCATIONAL NOTES

New York University receives $500,000 under the will of Miss Emily O Butler, of Scarsdale, N Y Most of Miss Butler's estate, which is valued in excess of $1,000,000, has been left for public uses, among other important legacies being one of $150,000 to the Union Theological Seminary The will provides that any property remaining after all the bequests are paid shall be divided equally between New York University and Union Theological Seminary

Princeton University is the remainder legatee under the will of Dr Clarence A McWilliams, well-known surgeon, who left an estate of $105,178 The estate is left in trust to Dr McWilliams's sisters during their life time

Dr Robert Langley Porter, former San Francisco city physician, who has spent the past two years in study at Rome, has been appointed dean of the Medical School of the University of California in San Francisco He will relieve Dr Lionel S Schmitt, acting dean, who has been serving at that post for five or six years

DR F L RANSOME, formerly geologist of the U S Geological Survey, has resigned from the faculty of the University of Arizona and has accepted the professorship of economic geology at the California Institute of Technology, Pasadena W P Woodring, of the survey, has been appointed professor of invertebrate paleontology

DR. LAURENCE IRVING, of Stanford University, has been appointed associate professor of physiology in the University of Toronto

DR J H MUIRHEAD, professor of philosophy at the University of Birmingham, England, and Bedford College, London, will serve as visiting professor of philosophy at the University of Southern California in the second semester

DR D L MACKINNON has been appointed as from August 1 to the chair of zoology in the University of London, tenable at King's College

DR JULIUS RUSKA, professor of the history of science at the University of Heidelberg, has been appointed director of the recently established Institute for the History of Science at Berlin

DISCUSSION

A NEGLECTED NOTE BY A NEGLECTED MAN

IN the course of a study being made on some of the chemical and physical properties of hydrofluoric acid,[1] a somewhat extensive review of the literature was instituted It was of interest during this work to consider the historic development of this acid from the time of its discovery

This search has been rewarded by the uncovering of a note that to my knowledge has not hitherto been recorded None of the treatises on historical chemistry or mineralogy, nor any of the extant bibliographies of the literature on this acid that I have had the opportunity of perusing has made any mention of this reference

The note referred to appears as a short (eleven pages) appended section to the second edition of Dr John Hill's treatise "Theophrastus's History of Stones With an English Version and Notes, etc" London, 1774 [2] This note (pages 267 to 278 incl) is, no doubt, based on a communication, or a series of communications, between the author and Karl Wilhelm Scheele, who announced his discovery of hydrofluoric acid in 1771 (Vetensk. Acad. Handl 1771)

This note is entitled "Observations on the new Swedish acid and of the stone from which it is obtained" This note is of much interest in that it so completely and accurately describes the production and properties of hydrofluoric acid and the mineralogical and chemical properties of fluorite

The "observations" are divided into two sections, the first dealing "Of the mineral acid in general" and the second "On the stone from which the Swedish acid is obtained" Many interesting and remarkably accurate observations are included in these few pages It may be of interest to give the details of the experiment

The Process by which I tried the Substance was this
Two Pounds of the green Kind of the Stone were powdered, and put into a Glass Retort,
Two Pounds of Oil of Vitriol were added to this,
And a Quart of Spirit of Wine was put into the Receiver
No Heat, nor Ebullition whatsoever, followed the Mixture for some Time, and in the End but little
The Vessels were closed, and kept in a Reverberatory Furnace for fourteen Hours
The Fire was slow at first, else the Matter would have risen over
No phosphorescent Light was visible at any Time
The Fumes were some Times visible, in the Receiver, at others not Whereas in the marine Acid they are never visible, unless Air be admitted
They were elastic, and had a Smell like those from Spirit of Salt
The Surface waved, and rose a little, and there was on it an icy, and gelatinous Substance
The upper Part of the Receiver became covered with a thin stony Crust
The *Swedes* speak of a Crust of absolute Flint, upon the Surface of the Liquor in the Receiver But they put Water there This was the same Substance, And it remained fix'd on Part of the Receiver While Part was displaced, probably by some light Vapour from the Spirit of Wine
The Corrosion of the Glass of the Retort seems to be an Effect of that peculiar Sublimation which rises in the Distillation, nay, and begins to rise, even without that Operation, For watching attentively the Effect of mixing the vitriolic Acid with the Stome, I perceived, that tho' they seemed to meet without any Effervescence, yet by Degrees there appeared a slight Commotion; which increased for a considerable Time, and, during which, this

[1] Berliner and Hann, SCIENCE *61* 498 (1925)

[2] Printed for the author, in St James's-Street and sold by L Davis, in Holborn, Norse, in the Strand, White, in Fleet Street, Cater, in Holborn, Bell, in the Strand, Fletcher, at Oxford, Woodyear, at Cambridge, and Bell, at Edinburgh 385 pp, 8°

This also appeared in a separate reprint the same year, the only alteration being the renumbering of the pages 16 pp, 8° (pages 1 to 5 are the title and cover pages) This is also printed for the author and sold by B. White, in Fleet-Street, and J Robson, in Bond Street.

My attention was called to this reprint, of which there is a copy in the Surgeon-General's Library at Washington, D. C, by Dr L L Woodruff

strange Sublimation of the Flores began to be made, and increased with it, even before any Fire was used. .

. After seven Hours a Hole was eaten thro' the Retort, and Fumes issued· But this was closed by a Crust formed of the matter within, and so well stopped, that no Vapour escaped .

The final appearance of the retort and nature and properties of the products of the reaction are described It is of interest that nowhere in this note is the term "hydrofluoric acid" employed, the mineral is on one occasion termed "fluor" Another omission for which no explanation is attempted, is the neglect of mentioning Scheele, his work, or the previously published observation Throughout the text the only allusion made as to the original work is the term "the Swedish acid or stone" In this note Hill discusses the rôle of this acid as a "mineralizer" in ore deposits This is also an uncredited observation and was "rediscovered" many years later Many other novel and seemingly precocious notations are recorded

The remarkable accuracy and extensiveness of these observations are to be marvelled at when one considers the many fields of learning in which Dr Hill ably distinguished himself Surprisingly little has been written concerning his life or accomplishments Recently Dr L L Woodruff, of Yale University, has published an excellent summary of this interesting man's career[3] for whom "One has but to turn the pages of London's print from 1750 to 1775 to meet his name" This short treatise gives a very clear, fair and intensely interesting outline of perhaps the most brilliant and least known character appearing in the history of science

Dr. Hill wrote extensively on many subjects, completing an almost unbelievable number of treatises during his life It has been said that "This gentleman may very justly be estimated as a phenomenon in literary history—he was perhaps one of the most voluminous writers that this or any other age has produced."

The diversity of his interests is indicated by the comprehensive number of subjects to which he made distinct contributions. His writings concern medicine, botany, zoology, astronomy, theology, philosophy, gardening, microscopy, pharmacology, animal husbandry, etiquette, mineralogy, naval and other histories, and in spite of all these studies he found time to edit *The British Magazine,* write a series of daily essays for a number of years, as well as publish several stories and plays. He was embroiled in innumerable polemics and wrote several satirical articles, one of the most interesting being "A Review of the Works of the Royal Society of London; containing animadversions on such papers as deserved particular observation," London, 1751, in which he ridicules some eighty original contributions to the society This and several other articles of a similar nature made many his enemy, and yet one said, as Dr Woodruff notes, "he was of all men I ever knew so mixed a character, none but himself can be his parallel"

[3] *The American Naturalist,* Vol. LX, 417–441 (1926)

J F T Berliner

Washington, D. C

ORGANIC FERTILIZERS AND COTTON WILT CONTROL

In a recent note (Science, n s, Vol 65, No 1695, p 616–617) H R Rosen refers to his experiments which indicate that no toxic effects are produced by *Fusarium vasinfectum* on cotton plants when organic nitrogen is used in the culture medium, and he suggests the possibility of field control of cotton wilt by the use of organic fertilizers He states "Orton's findings (U S Dept Agr *Farmers' Bul* 333, 1910), which have doubtless acted as a deterrent in the use of organic fertilizers for the control of wilt, are based on very little experimental data, and his results are contradicted by the work of Fulton (La Agr Exp Sta Bul 96, 1907) The writer has some data which seem to confirm Fulton's work"

The following quotations from the above-cited publication of W A Orton relate to the use of stable manure and other organic material in the practical control of cotton wilt where nematode root-knot is usually a complicating factor "The application of stable manure has been recommended as a remedy for wilt Our experience has been that in slightly infected fields this does give some relief, but that the wilt takes the field in the end in spite of the heaviest manuring The use of stable manure in growing resistant varieties of cotton has been very profitable however" Under the caption "Combined treatment of wilt and root-knot" he enumerates the following among the essential principles to be observed in arranging a rotation of crops "(1) To use crops immune to root-knot in order to starve out this pest (2) To build up the fertility of the soil, and especially to increase the amount of organic matter or humus" Definite rotations of soil improving crops are then suggested in detail

My recommendation of stable manure for cotton wilt control was based on two seasons' tests at Baton Rouge, Louisiana, on land very heavily infested with *Fusarium vasinfectum* and lightly infested with root-knot nematodes. It was not put forward as a sole preventive, but was to be used in connection with other control measures, such as the use of wilt-resistant cotton varieties and a crop rotation to reduce infestation.

Rosen himself thinks that "if nematodes are present, then the use of organic matter in such soil will not remove the possibility of wilt development, although it may partially alleviate the losses that might be incurred by stimulating the growth of the plant"

It is thus apparent that there is fundamentally very little difference in the three views in so far as they relate to the practical use of organic fertilizers in cotton wilt control under usual field conditions Rosen's present important work will doubtless stimulate further detailed investigation of the effectiveness of organic matter in the control of cotton wilt in the field, and it is hoped will lead to more extensive practical use of such material by cotton farmers, as has always been recommended as good practice by the pathologists of the U S Bureau of Plant Industry.

In this general connection reference may be made to the recent work by C J King and H F Loomis, of the U S Bureau of Plant Industry, on the control of cotton root-rot caused by *Phymatotrichum* (*Ozonium*) *omnivorum* (*Jour Agric Res*, 32 297–310, 1926), which is summarized in part as follows "Experiments conducted in the Salt River Valley and at Sacaton, Arizona, to test the effects of manure and other organic materials on the control of root-rot have consistently shown a reduction in the infected area and the number of cotton plants dying from the disease following the treatment"

H R. FULTON

WASHINGTON, D C

PLASMA CALCIUM

ACCORDING to the observations of Dr J B Collip as reported in *The Journal of Biological Chemistry*, Volume LXIV, June, 1925, the thyroparathyroidectomized dog is no more responsive to the plasma calcium-raising principle contained in a hydrochloric acid extract of bovine external parathyroid glands than the normal dog

Several tests on the effect of such an extract, prepared according to the method of the writer, have convinced us that the thyroparathyroidectomized albino rat is much more responsive to the calcium-raising principle than the normal albino rat

The parathyroid preparation used in these tests was one which had previously been standardized by testing its reaction on normal dogs. Fifteen milligrams of the preparation in 0 85 per cent sodium chloride solution produced an increase in the plasma calcium of a 12 to 13 kilogram dog, 3 to 4 milligrams, 15 to 17 hours following subcutaneous administration.

The potency of this preparation is further illustrated by citation to an experiment in which 60 milligrams was administered, in four doses of 15 milligrams each, to a 13 6 kilogram dog, during the course of 48 hours During that time six plasma calcium determinations were made The initial calcium value was 11 85 and the terminal value at which death occurred was 26 milligrams per 100 cc. of plasma.

When 15 milligrams of this preparation was administered to several normal albino rats, no noticeable increase above the normal value was found after seventeen hours Thirty milligrams administered in two equal doses seventeen hours apart were necessary to produce an increase of approximately 5 milligrams in the plasma calcium of a normal rat

Nine milligrams of the preparation was found to double the plasma calcium of a thyroparathyroidectomized rat of approximately the same weight, while 15 milligrams gave a value of 17 5 milligrams per 100 cc of plasma

We also found that as in the dog the plasma calcium value of the rat begins to drop very soon after parathyroidectomy After reaching a value between 5 and 8 milligrams per 100 cc of plasma, the calcium value has been found the same 200 days following thyroparathyroidectomy.

W R TWEEDY
S B CHANDLER

LOYOLA UNIVERSITY SCHOOL OF MEDICINE,
CHICAGO, ILLINOIS

THE ANCIENT AMERICAN CIVILIZATIONS AND CALENDARS

UNDER the above title and within a period of eight months I recently made a communication, consecutively, to the British Association for the Advancement of Science in Oxford, the International Congress of Americanists in Rome, the Anthropological Society of Washington, D C and the Sociedad Científica "Antonio Alzate" in Mexico City

In this communication I first pointed out that all the ancient American centers of civilization were situated between the tropics, that within this zone the year consists of two seasons only the dry and the wet and a striking phenomenon occurs, namely, the passage of the sun through the zenith twice a year, at irregular intervals, according to the differences of latitude

I next submitted irrefutable historical, documentary, archeological and pictorial proofs that the ancient astronomer-priests, inhabiting even widely separated parts of this tropical zone, observed the phenomenon by means of gnomons consisting of upright poles, stelae, pillars, altars or constructions with vertical walls, and interpreted the periodically recurring total disappearance of their shadows about noon, as

a "descent of the sun-god," whom they represented, pictorially and sculpturally, under the form of a human being descending head foremost or seated, at rest, within the solar disk, or under the form of different birds or of a jaguar. As in Mexico, when the phenomenon occurs towards the end of the dry season, it heralds the advent of rain generated by the heat of the vertical solar rays and as the growth of vegetation ensued, the ancient Mexican sages began their solar years at the moment when, marking the approach of the rainy season, the sun-god descended upon the gnomons and these cast no shadows

At the end of my communication to the Sociedad Antonio Alzate in Mexico City I made the suggestion that the ancient observation of the annual phenomenon, which marked the beginning of the Aztec New Year and is always allowed to pass by unobserved and unmentioned by the present inhabitants of the capital, be revived as a national school festival, which would be of educational and patriotic value as it would link the present with the past generations of native Mexicans My suggestion was received with enthusiasm by the president and members of the society and on May 18 the impressive phenomenon was observed in several schools in Mexico City, the most important celebration being held in the great courtyard of the new normal school under the auspices of its directors, Señor Aguirre and Señora Berlanga, of Señor Gallo, the director of the Astronomical Observatory, and of Señor Heliadoro del Valle, who, with other eminent professors, initiated a celebration in which over six thousand pupils took part with song and dance. The hope I also expressed that this beautiful nature festival will likewise be revived in other anciently inhabited centers within the tropical zone bids fair to be realized next year, as official representatives of Peru and Guatemala have already expressed their intention to recommend the adoption of the same school festival in their countries, and it is probable that others will follow suit.

I am at present engaged in preparing for publication a book containing the complete presentation of the results of my researches on the subject which have extended over thirty years.

Zelia Nuttall

Casa Alvarado,
Coyoacan D. F,
Mexico

QUOTATIONS

"YOUR MONEY'S WORTH"

No one group has done more to "debunk" the commercial practices of those dealing in the special merchandise of the group than has the medical profession. Furniture dealers are by no means agreed that it is in the public interest to let it be generally known that a table made of birchwood with a thin veneer of mahogany is not the "solid mahogany" of the advertisement; the gentlemen in "suits and cloaks" are far from agreeing that there is any moral defection in describing a garment of cotton and shoddy as "all-wool"; furriers still act on the principle that it is permissible to unload dyed muskrat on the public as "Hudson seal", the manufacturers of a well-known brand of soap admit privately that the slogan "99 and 44/100% pure" is a slogan rather than a fact. But, for over twenty years, the organized medical profession has attempted to bring to a minimum misrepresentation and deceit in the exploitation of medicinal products Physicians, then, as a class, will probably be more interested than any other one group in the book recently published under the title "Your Money's Worth," by Stuart Chase and F J Schlink. Neither of the authors is a physician, but both of them have been trained to clear thinking and, what is equally evident from their book, to a lucid expression of facts Mr Chase, for some years on the staff of the Federal Trade Commission and at present a director of the Labor Bureau, Incorporated, is by profession a certified public accountant Mr Schlink, a mechanical engineer-physicist and an officer of the American Engineering Standards Committee, is fortified by an experience he had of some years on the staff of the National Bureau of Standards at Washington. "Your Money's Worth" appeared originally as a series of magazine articles, under the title "Consumers in Wonderland" The book deals not so much with adulteration of products and deceptive advertising as outstanding evils of modern merchandising as with the wastefulness of selling what are practically identical articles under various brand names and with the absence of impartial information available to the public In a few of the industrial fields, the public is protected in its purchases by standardization worked out by the industry itself, but the ground thus covered is pitiably small Medicine, however, has reason to feel proud of the fact that it was among the first, both in point of time and of importance, in establishing agencies whereby the public, through the profession, could be protected In speaking of this phase of the problem, discussed by Messrs. Chase and Schlink, they say:

Far and away the leader among the technical societies from the point of view we are considering is the American Medical Association It is as fearless as it is explicit in the exposure of quackery. Its Council on Pharmacy and

Chemistry and its Bureau of Investigation are continuously busy in the public interest It has haled untold rascals before the bar of public opinion, broken up hundreds of shell games

We unreservedly recommend "Your Money's Worth" as a book that is not only readable and teeming with facts, but as one that will appeal to the physician, both in his professional capacity and also as one of the great army of ultimate consumers of modern merchandise —*The Journal of the American Medical Association*

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PRE-STAINING IN BOTANICAL MICRO-TECHNIQUE THE ALCOHOL-XYLOL-SAFRANIN METHOD

A few years ago the writer had occasion to imbed some small botanical objects in which it was important to section accurately with respect to the median axis. On clearing in xylol, the material became quite transparent, as so frequently happens, making it almost impossible to see the pieces in the paraffin block, much less to orient the material correctly for cutting. In the ribbon it was again difficult to find the small sections or to ascertain if the material was at all suitable for mounting and staining. The difficulties just enumerated are familiar to all technicians, whether small or large objects are dealt with and, as a result, much valuable time is lost, materials are ruined and the finished product is often thrown into the discard. The writer had read somewhere that it was possible to stain materials in bulk to render them more conspicuous, but details were lacking. Probably it was thought to be altogether too simple a procedure to require further elucidation Inquiries put to several technicians did not elicit much definite information This is not surprising, since few workers seem to be aware of the many advantages of prestaining in micro-technique.

A method of pre-staining was devised which was so generally successful with all kinds of materials and which required so little extra effort that all subsequent imbedding has been done in this way Not only are imbedding and cutting facilitated, but permanent mounts are also possible without extra labor. The plant parts are killed and fixed in the favorite fluid, and washing, hardening and dehydrating follow in the ordinary way The clearing is done in alcohol-xylol mixtures, a series of 5, 10, 30, 50, 75 and 100 per cent xylol in absolute alcohol being generally employed. The stain mixture is inserted in the series in place of the 75 per cent. alcohol-xylol It is prepared as follows: safranin is dissolved in absolute alcohol to make a saturated solution, 100 parts of the alcoholic safranin are mixed with 300 parts pure xylol. Some of the stain will precipitate out, and the mixture may be filtered, although this is not absolutely necessary. The material is run up through the lower percentages of xylol in alcohol through the 50 per cent. mixture and is then put directly into the safranin mixture, where it is left for 24 hours or longer, depending upon the size and quantity of the material to be stained. It will be seen that the material assumes a deep red color, the fluid at the same time becoming somewhat clear If much material is to be stained, the original solution may be replaced with fresh stain mixture There is no danger of over-staining From the stain mixture the material is run through pure xylol. This will bring down additional safranin as a precipitate, which may be removed by an extra washing with xylol. Embedding proceeds in the regular way. This becomes an easy task, even with small objects, and the pieces are easily seen in the paraffin block. Cutting is facilitated, and in the ribbon the sections stand out clearly The ribbon may be examined under the microscope and surplus and useless sections may be eliminated with certainty at once Mounting is done with a minimum of albumen fixative, using no more water than is necessary to smooth out the sections. Any excess water is immediately drained off and the slides are thoroughly dried with gentle heat. Twenty-four hours are not too long a time for drying, and an incubator is best used to eliminate dust and to guard against melting the paraffin. The slides may then be finished. The paraffin is removed with xylol in the ordinary way At this stage they may be examined under the microscope. The sections will be found to be beautifully stained, and every detail will stand out against a perfectly clear background A second elimination of unfit material may be made at this time with great certainty, and the only precaution necessary is to keep the slide wet with xylol during the period of examination. The slides may then be finished up by applying balsam and a cover-glass; or they may be run down through the alcohol series, which removes the stain, and any other staining method pursued.

It will thus be seen that this gives a method by which permanent mounts may be made quickly and easily. It is often desirable to make such preparations for temporary class use, and workers in certain fields will find the method adapted to many uses. Mounts thus made have been kept for months without apparent deterioration, the success being apparently determined by the elimination of all sources of water. If a safranin soluble only in alcohol were

possible of attainment, mounts made in this way would probably keep indefinitely. Diaphane has not been tried as a substitute for balsam

The advantages of the method may be summed up as follows

(1) Substitution of the stain mixture for 75 per cent. alcohol-xylol is hardly to be considered as an extra effort.

(2) The red objects, no matter how small, are readily visible, even in the hardened paraffin block

(3) Accuracy of cutting is facilitated

(4) The cut sections are quite visible in the ribbon and material may be examined superficially for accuracy of cutting, stages desired, etc.

(5) Unfit material is eliminated without further waste of time, and sections of value are not inadvertently thrown away

(6) Critical examination of material may be made in the stage of removing the paraffin.

(7) Finished mounts may be made at once, without the necessity of going through tedious processes, and especially the individual staining of slides

(8) Slides so made are fairly permanent.

(9) Slides not intended for quick mounting may be destained and subsequently treated to any other staining technique.

Chas. H. Otis

University of Wisconsin

A STUDY ON THE LIFE HISTORY OF THE BROAD FISH TAPEWORM IN NORTH AMERICA

Recently the committee on scientific research of the American Medical Association made a grant to the writer in support of a field study on the life history of the broad fish tapeworm, *Diphyllobothrium latum*. This species is a well-known and somewhat serious parasite of man in various regions of the Old World. It was first reported in the United States by Leidy, who studied in 1879 a specimen taken from an immigrant. Other cases which certainly were introduced have been reported from time to time and these records have increased rapidly in frequency within recent years.

The first case in the human host unquestionably infected by larvae bred in this country was reported by Nickerson in 1906 from the clinic of Dr. Parker, of Ely, Minn The patient was a boy only two years old who had never been out of the state and had never eaten imported fish. In 1911 Nickerson published data on 65 cases from Minnesota, including another record of local infection. Other indigenous cases have been reported by Warthin from Michigan, by Becker from Chicago, by Magath and by Riley from Minnesota, and by Lyon from Indiana. In some districts this species has come to be the most abundant and important human cestode, and this abundance is of very recent origin

The European form has been introduced into North America many times as more than one hundred cases in man were recorded up to 1922, the list has grown since then though many cases are still unpublished In fact in certain regions such instances have become too frequent to justify publication The ova of the parasites were disseminated by sewage systems and thus fishes in connecting rivers and lakes are infected The history of the parasite at Lake Geneva (Switzerland) is a striking illustration of the way in which the condition is caused and also corrected. No one has as yet shown that the parasite can find here intermediate hosts and the particular small crustacea functioning as such in Europe are rare or unknown here Moreover, since no accurate examination has been made of the adult tapeworms taken from man here, it may be that the hosts which were infected on this continent really sheltered a new, similar and yet unrecognized species and not the well-known type found in the Old World.

Closely related if not identical species have been reported from other hosts than man in this country, thus by Warthin from the gray fox in northern Michigan, and by Hall and Wigdor from the dog in Detroit. The latter authors regarded the form they described as a new species and named it *D. americanum* I have myself seen such a tapeworm taken from a dog at Ely, Minn, by Dr J. E Thompson. I have also adult tapeworms of this type collected from bears in the northwestern United States and in Alaska. The adult specimens from this continent have not been studied sufficiently precisely to justify a positive statement concerning their specific identity with the Old World species

The last larval stage, i e, the form by which the final host is infected, is known as a plerocercoid and occurs in various fish These plerocercoid larvae are so simple in structure and so imperfectly known that as yet no one can pass upon their relation to definite adult species I have often found such larval stages of bothriocephalid tapeworms in fish studied in various regions from the Great Lakes to Alaska. Nickerson also records finding such larvae but states distinctly that in the present state of knowledge it is impossible to determine the species to which they belong.

The rapid increase in the number of cases of human infection reported in the United States, the consequent increasing contamination of our streams with probable like increase in infection of fish, and the severe anemia incident to the parasitization of the

species in the Old World, no less than the general hygienic and biological interest associated with the problem, make it important to study the situation promptly and in such fashion as to secure exact information on the various aspects of the question

The American parasite in man may be identical with the European species, but, if not, two very similar species are now found side by side in certain regions At least one of them affects man and either one or both of them also occur in other hosts in these regions. On the abundance and distribution of the parasites in other hosts as well as in man depends the frequency of human cases.

The life cycle of the tapeworms in this country must be precisely determined, whether a new species is involved or not, since this life cycle need not necessarily be identical with that reported for Europe Evidently on the exact history of its varied relations to seasons and hosts depends both the manner and facility with which man is infected, and per contra the methods by which such infection may be regulated In this connection it is essential to consider not only the last larval host but also the earlier phases of the life cycle as well This is especially important since the species (*Cyclops leuckarti*) which in Europe serves as the first larval host is either rare or wanting on this continent.

Nickerson first showed that the source of human infection could be traced to a definite lake and Magath later demonstrated the occurrence of infected fish and thus of necessity infected intermediate hosts in a lake in the same general region. It is important to confirm these observations and to extend them to other waters for the purpose of determining the range and frequency of the parasite as well as the number and degree of infection of the intermediate hosts Field studies are essential in securing the facts in the case and thus in furnishing a safe basis for views as to the probable future history of the parasite and possible means for its control and ultimate eradication

With the purpose of studying the problem on the ground a field party has been organized and will carry on work this summer in northern Minnesota where the parasite has been so frequently reported This party is directly in charge of the writer. Dr T B Magath, of Rochester, Minn, will collaborate in the investigation and have control of the clinical experiments in particular Dr. H E Essex of the University of Illinois will study the early development of the parasite and carry on the experiments in the field Helpers will be secured as needed The U. S Bureau of Fisheries has undertaken to cooperate by sending an apprentice fish culturist to collect fish and maintain the aquaria The Mayo Foundation has made a substantial contribution to the enterprise by furnishing reagents, apparatus and other help.

The problem will be attacked at once from several different angles. One line of work involves securing eggs of the adult tapeworm, developing them in cultures and employing them in feeding experiments to determine the species of crustacea or other small aquatic organisms which can function as first intermediate hosts It may also be possible to collect naturally infected crustacea. The second stage in the life history will be sought by feeding such infected crustacea to small fish While the time may not suffice to allow of full development in such first intermediate hosts, undoubtedly the plerocercoid larvae can be obtained as they have been previously from various fish, large and small Among such specimens some will probably be sufficiently advanced in development to use in experiments with final hosts. In any event such material when carefully preserved and studied may show characters adequate to differentiate the plerocercoids of one bothriocephaloid tapeworm from those of another species Here again the conclusions can be tested by feeding experiments with various hosts

The problem can hardly be completely solved in a single summer, even with the varied attack planned But preserved specimens will afford opportunity for continuing the study in my laboratory during the winter Efforts will also be made to secure and transport living material so that feeding experiments can be continued there.

Henry B. Ward

Zoological Laboratory,
University of Illinois

SPECIAL ARTICLES

THE TOXICOLOGY OF CARBON MONOXIDE

The toxicology of carbon monoxide gas always raises the mooted question as to whether carbon monoxide is poisonous *per se* or produces all its toxic effects from interference with proper oxygenation of tissues In all higher animals it has been the general opinion of most pharmacologists that carbon monoxide is poisonous by virtue of its combining with hemoglobin to form CO hemoglobin and thus preventing the hemoglobin from combining with oxygen. The affinity of carbon monoxide for hemoglobin has been found to be some two hundred times greater than its affinity for oxygen Carbon monoxide gas of itself is commonly regarded as being physiologically inert. Some recent work however seems to indicate that carbon monoxide is not as innocuous *per se* as it has been supposed to be. Thus Warburg (*Biochem. Zeit.*, 177, pp. 471, 1926) has shown that car-

bon monoxide may act as a poison in the absence of hemoglobin. He observed that carbon monoxide depresses the rate of oxygen consumption by yeasts and that the amount of carbon monoxide required to produce a given effect increased with a partial pressure of oxygen. Again, Haldane in a recent note (*Nature*, March 5, 1927, page 352) extended these observations to two higher organisms, wax moths, *Galleria mellonella* and the cress plant *Lepidium sativum*. He found that the moths behaved normally in as little as 2 per cent of oxygen at atmospheric pressure, provided this gas is diluted with nitrogen When however the oxygen is diluted with carbon monoxide about 16 per cent of oxygen is needed for normal behavior With smaller amounts of oxygen carbon monoxide is poisonous Haldane also found that cress seeds do not germinate in an atmosphere of oxygen containing a certain amount of carbon monoxide.

In connection with the above observations the author wishes to call attention to certain observations which he has made and concerning which a brief note was published already (Macht, Blackman and Swigart, *Proc of Exp. Bio. and Med.*, 1924, Vol. 91, pp 227) While engaged in the study of the effects of various drugs and toxins on the growth of the seedlings of *Lupinus albus* studies were made on the growth of such seedlings in weak solutions of blood and hemoglobin The procedure briefly consisted in growing seedlings of *Lupinus albus* in upright test tubes containing equal parts of distilled water and a plant physiological solution (Shive) on the one hand, and of other seedlings of *Lupinus albus* in exactly the same control solution plus small amounts of unknown substances to be studied The elongation of the straight and well-defined roots was measured accurately in each case. It was found that 1 per cent solutions of blood give a growth index as compared with a growth in normal nutrient solution without blood of about 72 per cent. Having studied repeatedly the effect of normal blood and normal hemoglobin solutions on the growth of *Lupinus albus* seedlings in the dark, experiments were made on the growth of the seedlings in solutions of blood containing various amounts of carbon monoxide hemoglobin. Here a new and unexpected observation was made It was found the solution of carbon monoxide hemoglobin produced a poisonous effect on the seedlings as shown by an inhibition of their growth. The following four protocols will serve as illustrations.

Experiment November 3, 1925

Defibrated blood of a pig was saturated with pure carbon monoxide obtained by the addition of concentrated sulphuric acid to formic acid. A 1 per cent. solution of the normal pig's blood was made in Shive solution as described above; another 1 per cent. solution was made of the blood which was saturated with carbon monoxide. A third solution was made containing 0 5 per cent. of the monoxide blood Ten seedlings each of *Lupinus albus* were carefully measured and immersed in each of the above solutions and all of the plants were left in the dark at a temperature of 22° C After eighteen hours it was found that the growth of the seedlings in normal blood gave an index of 75 per cent. Growth in 1 per cent carbon monoxide blood gave an index of 37 per cent. Growth in 0 5 per cent of carbon monoxide blood gave an index of 48 per cent.

Experiment October 9, 1925

Specimen of blood was obtained from a normal rabbit and a 1 per cent solution was made The rabbit was then allowed to inhale pure carbon monoxide until first signs of intoxication appeared Blood was then drawn and it was found to contain about 30 per cent. of carbon monoxide hemoglobin The growth of seedlings in a normal blood solution, and the blood obtained after inhaling carbon monoxide gave the following figures: Growth in normal blood 1 per cent. gave index of 72 per cent. Growth in carbon monoxide blood 1 per cent gave index of 60 per cent

Experiment March 31, 1927

A rat was killed with carbon monoxide gas The relative indices of growth in 1 per cent of normal rat blood and 1 per cent of blood from the poisoned animal were as follows Normal 75 per cent, carbon monoxide blood 47 per cent

Experiment April 6, 1927

Pigeon was allowed to inhale carbon monoxide until convulsions occurred Growth in solution of 1 per cent. of its blood was compared with growth in a 1 per cent. solution of normal pigeon's blood The following results were obtained. Growth in normal blood 70 per cent, growth in carbon monoxide blood 50 per cent.

Similar experiments were performed with bloods of men and several other animals In each case it was found that the growth of *Lupinus albus* seedlings was markedly inhibited by solutions of carbon monoxide blood and also solutions of pure carbon monoxide hemoglobin. It was found that in cases of very sensitive preparations a definite inhibition in growth of seedlings could be noted in solutions of monoxide blood diluted to 0 01 per cent. when the preparations were kept in the *dark* and at a temperature of 20° C. The above observations speak in favor of poisonous effects produced by carbon monoxide or rather carbon monoxide hemoglobin apart from an interference with oxygenation processes.

David I. Macht
Pharmacological Research Laboratory,
Hynson, Westcott & Dunning,
Baltimore, Maryland

ON THE THICKNESS OF THE HELMHOLTZ DOUBLE LAYER

HELMHOLTZ and Lamb assumed the double electric layer around colloid particles to be of molecular dimensions, but Gouy calculated it to be greater and to increase with dilution of the solution. Whereas the diameter of a water molecule is about 0.03×10^{-6} cm, Gouy calculated the distance (a) between the surface of a colloid particle (having 10 electrostatic units of charge per sq. cm of surface) and the center of gravity of the excess ions of opposite sign in a 0.1 N solution of monovalent salt at 18° to be 0.096×10^{-6} cm, and in a 0.001 N solution 0.96×10^{-6} cm. Gouy assumed a dielectric constant of 80. Burton showed that Gouy's a was equal to Debye's $\frac{1}{K}$. Burton and Currie showed experimentally that the Helmholtz double layer was thick enough to account for repulsion between colloid particles as well as larger bodies (shot) and that its thickness increases with dilution. They account for the discharge of colloid particles on the addition of salts by the thinning of the double layer to the point of break-down of the dielectric.

In previous papers (McClendon-1926) it has been shown that the double layer acts as a condenser and becomes thicker the greater the dilution of the solution. It was hoped that a method might be found to measure its thickness.

Since the surface of a charged metal electrode (immersed in an electrolyte solution) and the layer of excess ions of opposite sign act as the plates of a condenser whose capacity may be measured, knowing the dielectric constant, the thickness of the Helmholtz double layer may be calculated. The capacity in microfarads, $C = 0.0885 \times 10^{-6} \frac{KS}{T}$, where S is the surface area of the electrode in cm^2, T is the thickness of the dielectric (Helmholtz double layer) and K the dielectric constant. The conductivity vessel contained two bright gold electrodes each of 10 cm^2 surface (5 cm^2 face and 5 cm^2 back) and acted as two condensers in series, equivalent to one condenser with double the thickness of dielectric. Assuming $K = 80$ the equation becomes

$$T = \frac{7.08}{C} \times 10^{-6} \text{ cm}$$

and the thickness of the Helmholtz layer will be $\frac{T}{2}$.

The capacity is most easily measured using alternating current, but since it changes slightly with frequency the electrostatic value can only be approximated.

As will be seen from the table the thickness of the Helmholtz layer as measured is for 0.1 N solution 0.194×10^{-6} cm whereas Gouy calculated 0.096×10^{-6} cm, a fairly close agreement particularly in view of the uncertainty of the dielectric constant. The measured value for 0.001 N solution, 0.325×10^{-6} cm, is far from Gouy's value of 0.96×10^{-6} cm, but the change is in the right direction, *i. e.*, increase in thickness of the Helmholtz layer with dilution of the electrolyte.

Frequency in cycles per second	Normality KCl	Capacity microfarads	$\frac{T}{2}$ Unit 10^{-6} cm	Normality KCl	Capacity microfarads	Unit 10^{-6} cm $\frac{T}{2}$
436	0.0002	11.3	0.318	—	-	—
640	"	10.7	—	—	—	—
885	"	10.2	-	0.001	11.0	—
1000	"	9.7	0.365	"	10.9	0.325
1375	"	9.5	—	"	10.5	—
1720	"	—	—	"	10.3	—
1950	"	8.4	—	"	9.8	—
2820	"	6.7	-	"	9.2	—
4420	"	4.2	0.843	"	7.3	—
1000	0.002	15.3	0.231	0.01	14.2	0.249
1000	"	-	—	0.1	18.3	0.194

The fact that the thickness of the Helmholtz layer increases with frequency of the alternating current might be explained by lack of time for the ions to migrate to their definitive positions.[1]

J. F. MCCLENDON

MEDICAL SCHOOL OF THE
UNIVERSITY OF MINNESOTA

[1] Burton, E. F., Colloid Symposium, Monograph 4: 132, 1926.

Burton and Currie, J. E., *Phil. Mag.* 49: 194, 1925.

Circular of the Bureau of Standards No. 74, p. 109, 1918.

Gouy, *J. de phys.* (4) 9: 457, 1910.

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DARWIN'S THEORY OF MAN'S DESCENT AS IT STANDS TO-DAY[1]

MY LORD MAYOR, MR VICE-CHANCELLOR, LADIES AND GENTLEMEN,

My first duty as your president, and it is a very pleasant one, is to send the following message in your name to H R H The Prince of Wales:

YOUR ROYAL HIGHNESS,

The British Association for the Advancement of Science, now assembled in Leeds to begin another session, can not allow your year of office to terminate without offering to you sincere and humble congratulations on the happy results which have attended your presidency A year ago, in the historic city of Oxford, you did British science the signal honor of coming among us as our president, the meeting you then inaugurated set a standard which future gatherings will strive to emulate The inspiring message you then addressed to us, and through us to men of science in every part of the empire, has already borne fruit We are within sight of a closer union, for which the association itself has always striven, between men of science overseas and their colleagues at home, in their endeavor to solve problems of imperial concern It is too soon as yet to assess the value of the harvest of science planted under your ægis, for the best vintages of science mature slowly, but of this we are certain the interest Your Royal Highness has taken in the work of this association will prove a permanent source of encouragement for all who work for the betterment of life through increase of knowledge To night we proudly add your presidential banner to those of the great men of science who have presided over this association since its inception at York ninety six years ago

In olden times men kept their calendars by naming each year according to its outstanding event. I have no doubt that in future times the historian of this association, when he comes to distinguish the presidential year which opened so auspiciously in Oxford twelve months ago, will be moved to revert to this ancient custom and name it the Prince's Year And I am under no misapprehension as to what will happen when our historian comes to the term which I have now the honor of inaugurating at Leeds, he will immediately relapse to the normal system of numerical notation. Nor will our historian fail to note, should he be moved to contrast the meeting at Oxford with

[1] The presidential address before the British Association for the Advancement of Science given at Leeds on August 31.

that which now begins at Leeds, that some mischievous sprite seems to have tampered with the affairs of this association For how otherwise could he explain the fortune which fell to ancient Oxford, the home of history? To her lot fell a brilliant discourse on the application of science to the betterment of human lives, while Leeds, a city whose life's blood depends on the successful application of science to industry, had to endure, as best she could, a discourse on a theme of ancient history For the subject of my address is man's remote history Fifty-five years have come and gone since Charles Darwin wrote a history of man's descent How does his work stand the test of time? This is the question I propose to discuss with you to-night in the brief hour at my disposal

In tracing the course of events which led up to our present conception of man's origin, no place could serve as a historical starting-point so well as Leeds In this city was fired the first verbal shot of that long and bitter strife which ended in the overthrow of those who defended the Biblical account of man's creation and in a victory for Darwin On September 24, 1858—sixty-nine years ago—the British Association assembled in this city just as we do to-night, Sir Richard Owen, the first anatomist of his age, stood where I now stand He had prepared a long address, four times the length of the one I propose to read, and surveyed, as he was well qualified to do, the whole realm of science, but only those parts which concern man's origin require our attention now He cited evidence which suggested a much earlier date for the appearance of man on earth than was sanctioned by Biblical records, but poured scorn on the idea that man was merely a transmuted ape He declared to the assembled association that the differences between man and ape were so great that it was necessary, in his opinion, to assign mankind to an altogether separate order in the animal kingdom As this statement fell from the president's lips there was at least one man in the audience whose spirit of opposition was roused—Thomas Henry Huxley—Owen's young and rising antagonist

I have picked out Huxley from the audience because it is necessary, for the development of my theme, that we should give him our attention for a moment. We know what Huxley's feelings were towards Owen at the date of the Leeds meeting Six months before, he had told his sister that "an internecine feud rages between Owen and myself," and on the eve of his departure for Leeds he wrote to Hooker "The interesting question arises shall I have a row with the great O there?" I am glad to say the Leeds meeting passed off amicably, but it settled in Huxley's mind what the "row" was to be about when it came It was to concern man's rightful position in the scale of living things.

Two years later, in 1860, when this association met in Oxford, Owen gave Huxley the opportunity he desired In the course of a discussion Owen repeated the statement made at Leeds as to man's separate position, claiming that the human brain had certain structural features never seen in the brain of anthropoid apes Huxley's reply was a brief and emphatic denial with a promise to produce evidence in due course—which was faithfully kept This opening passage at arms between our protagonists was followed two days later by that spectacular fight—the most memorable in the history of our association—in which the Bishop of Oxford, the representative of Owen and of orthodoxy, left his scalp in Huxley's hands To make his victory decisive and abiding, Huxley published, early in 1863, "The Evidences of Man's Place in Nature," a book which has a very direct bearing on the subject of my discourse It settled for all time that man's rightful position is among the primates, and that, as we anatomists weigh evidence, his nearest living kin are the anthropoid apes.

My aim is to make clear to you the foundations on which rest our present-day conception of man's origin The address delivered by my predecessor from this chair at the Leeds meeting of 1858 has given me the opportunity of placing Huxley's fundamental conception of man's nature in a historical setting I must now turn to another issue which Sir Richard Owen merely touched upon but which is of supreme interest to us now He spent the summer in London, just as I have done, writing his address for Leeds and keeping an eye on what was happening at scientific meetings In his case something really interesting happened Sir Charles Lyell and Sir Joseph Hooker left with the Linnean Society what appeared to be an ordinary roll of manuscript, but what in reality was a parcel charged with high explosives, prepared by two very innocent-looking men—Alfred Russel Wallace and Charles Darwin As a matter of honesty it must be admitted that these two men were well aware of the deadly nature of its contents, and knew that if an explosion occurred, man himself, the crown of creation, could not escape its destructive effects Owen examined the contents of the parcel and came to the conclusion that they were not dangerous, at least, he manifested no sign of alarm in his presidential address He dismissed both Wallace and Darwin, particularly Darwin, in the briefest of paragraphs, at the same time citing passages from his own work to prove that the conception of natural selection as an evolutionary force was one which he had already recognized.

As I address these words to you I can not help marvelling over the difference between our outlook to-day and that of the audience which Sir Richard Owen had to face in this city sixty-nine years ago. The vast assemblage which confronted him was convinced, al-

most without a dissentient, that man had appeared on earth by a special act of creation, whereas the audience which I have now the honor of addressing, and that larger congregation which the wonders of wireless bring within the reach of my voice, if not convinced Darwinists are yet prepared to believe, when full proofs are forthcoming, that man began his career as a humble primate animal, and has reached his present estate by the action and reaction of biological forces which have been and are ever at work within his body and brain

This transformation of outlook on man's origin is one of the marvels of the nineteenth century, and to see how it was effected we must turn our attention for a little while to the village of Down in the Kentish uplands and note what Charles Darwin was doing on the very day that Sir Richard Owen was delivering his address here in Leeds He sat in his study struggling with the first chapter of a new book, but no one foresaw, Owen least of all, that the publication of the completed book, *The Origin of Species*, fifteen months later (1859), was to effect a sweeping revolution in our way of looking at living things and to initiate a new period in human thought—the Darwinian period—in which we still are Without knowing it, Darwin was a consummate general He did not launch his first campaign until he had spent twenty-two years in stocking his arsenal with ample stores of tested and assorted fact Having won territory with *The Origin of Species*, he immediately set to work to consolidate his gains by the publication in 1868 of another book, *The Variation of Animals and Plants under Domestication*—a great and valuable treasury of biological observation Having thus established an advanced base, he moved forwards on his final objective—the problem of human beginnings—by the publication of *The Descent of Man* (1871), and that citadel capitulated to him To make victory doubly certain he issued in the following year—1872—*The Expression of the Emotions in Man and Animals* Many a soldier of truth had attempted this citadel before Darwin's day, but they failed because they had neither his generalship nor his artillery

Will Darwin's victory endure for all time? Before attempting to answer this question, let us look at what kind of book *The Descent of Man* is. It is a book of history—the history of man, written in a new way —the way discovered by Charles Darwin Permit me to illustrate the Darwinian way of writing history If a history of the modern bicycle had to be written in the orthodox way, then we should search dated records until every stage was found which linked the two-wheeled hobby-horse, bestrode by tall-hatted fashionable men at the beginning of the nineteenth century, to the modern "jeopardy" which now flashes past us in country lanes But suppose there were no dated records—only a jumble of antiquated machines stored in the cellar of a museum We should, in this case, have to adopt Darwin's way of writing history By an exact and systematic comparison of one machine with another we could infer the relationship of one to another and tell the order of their appearance, but as to the date at which each type appeared and the length of time it remained in fashion, we could say very little. It was by adopting this circumstantial method that Darwin succeeded in writing the history of man He gathered historical documents from the body and behavior of man and compared them with observations made on the body and behavior of every animal which showed the least resemblance to man He studied all that was known in his day of man's embryological history and noted resemblances and differences in the corresponding histories of other animals He took into consideration the manner in which the living tissues of man react to disease, to drugs and to environment, he had to account for the existence of diverse races of mankind By a logical analysis of his facts Darwin reconstructed and wrote a history of man

Fifty-six years have come and gone since that history was written, an enormous body of new evidence has poured in upon us We are now able to fill in many pages which Darwin had perforce to leave blank, and we have found it necessary to alter details in his narrative, but the fundamentals of Darwin's outline of man's history remain unshaken Nay, so strong has his position become that I am convinced that it never can be shaken

Why do I say so confidently that Darwin's position has become impregnable? It is because of what has happened since his death in 1882 Since then we have succeeded in tracing man by means of his fossil remains and by his stone implements backwards in time to the very beginning of that period of the earth's history to which the name Pleistocene is given We thus reach a point in history which is distant from us at least 200,000 years, perhaps three times that amount Nay, we have gone farther, and traced him into the older and longer period which preceded the Pleistocene—the Pliocene It was in strata laid down by a stream in Java during the latter part of the Pliocene period that Dr Eugene Dubois found, ten years after Darwin's death, the fossil remains of that remarkable representative of primitive humanity to which he gave the name *Pithecanthropus*, or ape-man; from Pliocene deposits of East Anglia Mr Reid Moir has recovered rude stone implements If Darwin was right, then as we trace man backwards in the scale of time he should become more bestial in form—nearer to the ape. That is what we have found. But if we

regard *Pithecanthropus* with his small and simple yet human brain as a fair representative of the men of the Pliocene period, then evolution must have proceeded at an unexpectedly rapid rate to culminate to-day in the higher races of mankind

The evidence of man's evolution from an ape-like being, obtained from a study of fossil remains, is definite and irrefutable, but the process has been infinitely more complex than was suspected in Darwin's time Our older and discarded conception of man's transformation was depicted in that well-known diagram which showed a single file of skeletons, the gibbon at one end and man at the other In our original simplicity we expected, as we traced man backwards in time, that we should encounter a graded series of fossil forms—a series which would carry him in a straight line towards an anthropoid ancestor We should never have made this initial mistake if we had remembered that the guide to the world of the past is the world of the present In our time man is represented not by one but by many and diverse races—black, brown, yellow and white, some of these are rapidly expanding, others are as rapidly disappearing Our searches have shown that in remote times the world was peopled, sparsely it is true, with races showing even a greater diversity than those of to-day, and that already the same process of replacement was at work To unravel man's pedigree, we have to thread our way, not along the links of a chain, but through the meshes of a complicated network

We made another mistake Seeing that in our search for man's ancestry we expected to reach an age when the beings we should have to deal with would be simian rather than human, we ought to have marked the conditions which prevail amongst living anthropoid apes We ought to have been prepared to find, as we approached a distant point in the geological horizon, that the forms encountered would be as widely different as are the gorilla, chimpanzee and orang, and confined, as these great anthropoids now are, to limited parts of the earth's surface That is what we are now realizing, as we go backwards in time we discover that mankind becomes broken up, not into separate races as in the world of to-day, but into numerous and separate species When we go into a still more remote past they become so unlike that we have to regard them not as belonging to separate species but different genera. It is amongst this welter of extinct fossil forms which strew the ancient world that we have to trace the zigzag line of man's descent. Do you wonder we sometimes falter and follow false clues?

We committed a still further blunder when we set out on the search for man's ancestry indeed, some of us are still making it We expected that man's evolution would pursue not only an orderly file of stages, but that every part of his body—skull, brain, jaws, teeth, skin, body, arms and legs—would at each stage become a little less ape-like, a little more man-like. Our searches have shown us that man's evolution has not proceeded in this orderly manner In some extinct races, while one part of the body has moved forwards another part has lagged behind. Let me illustrate this point because it is important We now know that, as Darwin sat in his study at Down, there lay hidden at Piltdown, in Sussex, not thirty miles distant from him, sealed up in a bed of gravel, a fossil human skull and jaw In 1912, thirty years after Darwin's death, Mr Charles Dawson discovered this skull and my friend Sir Arthur Smith Woodward described it, and rightly recognized that skull and jaw were parts of the same individual, and that this individual had lived, as was determined by geological and other evidence, in the opening phase of the Pleistocene period We may confidently presume that this individual was representative of the people who inhabited England at this remote date The skull, although deeply mineralized and thick-walled, might well have been the rude forerunner of a modern skull, but the lower jaw was so ape-like that some experts denied that it went with the human fossil skull at all, and supposed it to be the lower jaw of some extinct kind of chimpanzee This mistake would never have been made if those concerned had studied the comparative anatomy of anthropoid apes Such a study would have prepared them to meet with the discordances of evolution. The same irregularity in the progression of parts is evident in the anatomy of *Pithecanthropus*, the oldest and most primitive form of humanity so far discovered The thigh-bone might easily be that of modern man, the skull-cap that of an ape, but the brain within that cap, as we now know, had passed well beyond an anthropoid status. If merely a lower jaw had been found at Piltdown an ancient Englishman would have been wrongly labelled "Higher anthropoid ape"; if only the thigh-bone of *Pithecanthropus* had come to light in Java, then an ancient Javanese, almost deserving the title of anthropoid, would have passed muster as a man

Such examples illustrate the difficulties and dangers which beset the task of unravelling man's ancestry. There are other difficulties, there still remain great blanks in the geological record of man's evolution. As our search proceeds these blanks will be filled in, but in the meantime let us note their nature and their extent By the discovery of fossil remains we have followed man backwards to the close of the Pliocene—a period which endured at least for a quarter of a million years, but we have not yet succeeded in tracing him through this period. It is true that we have found fossil teeth in Pliocene deposits which may be those of

an ape-like man or of a man-like ape; until we find other parts of their bodies we can not decide. When we pass into the still older Miocene period—one which was certainly twice as long as the Pliocene—we are in the heyday of anthropoid history Thanks to the labors of Dr Guy E Pilgrim, of the Indian Geological Survey, we know already of a dozen different kinds of great anthropoids which lived in Himalayan jungles during middle and later Miocene times, we know of at least three other kinds of great anthropoids which lived in the contemporary jungles of Europe Unfortunately we have found as yet only the most resistant parts of their bodies—teeth and fragments of jaw Do some of these fragments represent a human ancestor? We can not decide until a lucky chance brings to light a limb-bone or a piece of skull, but no one can compare the teeth of these Miocene anthropoids with those of primitive man, as has been done so thoroughly by Professor William K Gregory, and escape the conviction that in the dentitions of the extinct anthropoids of the Miocene jungles we have the ancestral forms of human teeth

It is useless to go to strata still older than the Miocene in search of man's emergence, in such strata we have found only fossil traces of emerging anthropoids All the evidence now at our disposal supports the conclusion that man has arisen, as Lamarck and Darwin suspected, from an anthropoid ape not higher in the zoological scale than a chimpanzee, and that the date at which human and anthropoid lines of descent began to diverge lies near the beginning of the Miocene period On our modest scale of reckoning, that gives man the respectable antiquity of about one million years

Our geological search, which I have summarized all too briefly, has not produced so far the final and conclusive evidence of man's anthropoid origin, we have not found as yet the human *imago* emerging from its anthropoid encasement Why, then, do modern anthropologists share the conviction that there has been an anthropoid stage in our ancestry? They are no more blind than you are to the degree of difference which separates man and ape in structure, in appearance and in behavior I must touch on the sources of this conviction only in a passing manner Early in the present century Professor G H F Nuttall, of Cambridge University, discovered a trustworthy and exact method of determining the affinity of one species of animal to another by comparing the reactions of their blood. He found that the blood of man and that of the great anthropoid apes gave almost the same reaction. Bacteriologists find that the living anthropoid body possesses almost the same susceptibilities to infections, and manifests the same reactions, as does the body of man. So alike are the brains of man and anthropoid in their structural organization that surgeons and physiologists transfer experimental observations from the one to the other When the human embryo establishes itself in the womb it throws out structures of a most complex nature to effect a connection with the maternal body We now know that exactly the same elaborate processes occur in the anthropoid womb and in no other We find the same vestigial structures—the same "evolutionary postmarks"—in the bodies of man and anthropoid The anthropoid mother fondles, nurses and suckles her young in the human manner This is but a tithe of the striking and intimate points in which man resembles the anthropoid ape In what other way can such a myriad of coincidences be explained except by presuming a common ancestry for both?

The crucial chapters in Darwin's *Descent of Man* are those in which he seeks to give a historical account of the rise of man's brain and of the varied functions which that organ subserves How do these chapters stand to-day? Darwin was not a professional anatomist and therefore accepted Huxley's statement that there was no structure in the human brain that was not already present in that of the anthropoid In Huxley's opinion the human brain was but a richly annotated edition of the simpler and older anthropoid book, and this edition, in turn, was but the expanded issue of the still older original primate publication Since this statement was made thousands of anatomists and physiologists have studied and compared the brain of man and ape, only a few months ago Professor G Elliot Smith summarized the result of this intensive enquiry as follows "No structure found in the brain of an ape is lacking in the human brain, and, on the other hand, the human brain reveals no formation *of any sort* that is not present in the brain of the gorilla or chimpanzee The only distinctive feature of the human brain is a quantitative one." The difference is only quantitative but its importance can not be exaggerated In the anthropoid brain are to be recognized all those parts which have become so enormous in the human brain It is the expansion of just those parts which have given man his powers of feeling, understanding, acting, speaking and learning

Darwin himself approached this problem not as an anatomist but as a psychologist, and after many years of painstaking and exact observation, succeeded in convincing himself that, immeasurable as are the differences between the mentality of man and ape, they are of degree, not of kind. Prolonged researches made by modern psychologists have but verified and extended Darwin's conclusions. No matter what line of evidence we select to follow—evidence gathered by anatomists, by embryologists, by physiologists or by

psychologists—we reach the conviction that man's brain has been evolved from that of an anthropoid ape and that in the process no new structure has been introduced and no new or strange faculty interpolated

In these days our knowledge of the elaborate architecture and delicate machinery of the human brain makes rapid progress, but I should mislead if I suggested that finality is in sight Far from it, our enquiries are but begun There is so much we do not yet understand Will the day ever come when we can explain why the brain of man has made such great progress while that of his cousin the gorilla has fallen so far behind? Can we explain why inherited ability falls to one family and not to another, or why, in the matter of cerebral endowment, one race of mankind has fared so much better than another? We have as yet no explanation to offer, but an observation made twenty years ago by one on whom nature has showered great gifts—a former president of this association and the doyen of British zoologists—Sir E Ray Lankester—deserves quotation in this connection "The leading feature in the development and separation of man from other animals is undoubtedly the relative enormous size of the brain in man and the corresponding increase in its activities and capacity It is a striking fact that it was not in the ancestors of man alone that this increase in the size of the brain took place at this same period—the Miocene Other great mammals of the early Tertiary period were in the same case" When primates made their first appearance in geological records, they were, one and all, small-brained We have to recognize that the tendency to increase of brain, which culminated in the production of the human organ, was not confined to man's ancestry but appeared in diverse branches of the mammalian stock at a corresponding period of the earth's history

I have spoken of Darwin as a historian To describe events and to give the order of their occurrence is the easier part of a historian's task, his real difficulties begin when he seeks to interpret the happenings of history, to detect the causes which produced them and explain why one event follows as a direct sequel to another Up to this point we have been considering only the materials for man's history, and placing them, so far as our scanty information allows, in the order of their sequence, but now we have to seek out the biological processes and controlling influences which have shaped the evolutionary histories of man and ape The evolution of new types of man or of ape is one thing, and the evolution of new types of motor cars is another, yet for the purposes of clear thinking it will repay us to use the one example to illustrate the other In the evolution of motor vehicles Darwin's law of selection has prevailed, there has been severe competition and the types which have answered best to the needs and tastes of the public have survived The public has selected on two grounds —first for utility, thus illustrating Darwin's law of natural selection, and secondly because of appearance's sake, for, as most people know, a new car has to satisfy not only the utilitarian demands of its prospective master but also the esthetic tastes of its prospective mistress, therein illustrating Darwin's second law—the law of sexual selection That selection, both utilitarian and esthetic, is producing an effect on modern races of mankind and in surviving kinds of ape, as Darwin supposed, can not well be questioned In recent centuries the inter-racial competition amongst men for the arable lands of the world is keener than in any known period of human history

The public has selected its favored types of car, but it has had no direct hand in designing and producing modifications and improvements which have appeared year after year To understand how such modifications are produced the enquirer must enter a factory and not only watch artisans shaping and fitting parts together but also visit the designer's office In this way an enquirer will obtain a glimpse of the machinery concerned in the evolution of motor cars. If we are to understand the machinery which underlies the evolution of man and of ape, we have to enter the "factories" where they are produced—look within the womb and see the ovum being transformed into an embryo, the embryo into a foetus and the foetus into a babe After birth we may note infancy passing into childhood, childhood into adolescence, adolescence into maturity and maturity into old age Merely to register the stages of change is not enough, to understand the controlling machinery we have to search out and uncover the processes which are at work within developing and growing things and the influences which coordinate and control all the processes of development and of growth When we have discovered the machinery of development and of growth we shall also know the machinery of evolution, for they are the same

If the simile I have used would sound strange in Darwin's ear, could he hear it, the underlying meaning would be familiar to him Over and over again he declared that he did not know how "variations" were produced, favorable or otherwise, nor could he have known, for in his time hormones were undreamt of and experimental embryology scarcely born. With these recent discoveries new vistas opened up for students of evolution The moment we begin to work out the simile I have used and compare the evolutionary machinery in a motor factory with that which regulates the development of an embryo within the womb, we realize how different the two processes are. Let

us imagine for a moment what changes would be necessary were we to introduce "embryological processes" into a car factory We have to conceive a workshop teeming with clustering swarms of microscopic artisans, mere specks of living matter In one end of this factory we find swarms busy with cylinders, and as we pass along we note that every part of a car is in process of manufacture, each part being the business of a particular brigade of microscopic workmen There is no apprenticeship in this factory, every employee is born, just as a hive-bee is, with his skill already fully developed No plans or patterns are supplied, every workman has the needed design in his head from birth There is neither manager, overseer nor foreman to direct and coordinate the activities of the vast artisan armies And yet if parts are to fit when assembled, if pinions are to mesh and engines run smoothly, there must be some method of coordination It has to be a method plastic enough to permit difficulties to be overcome when such are encountered and to permit the introduction of advantageous modifications when these are needed A modern works manager would be hard put to it were he asked to devise an automatic system of control for such a factory, yet it is just such a system that we are now obtaining glimpses of in the living workshops of nature.

I have employed a crude simile to give the lay mind an inkling of what happens in that "factory" where the most complicated of machines are forged—the human body and brain The fertilized ovum divides and redivides, one brood of microscopic living units succeeds another, and as each is produced the units group themselves to form the "parts" of an embryo Each "part" is a living society; the embryo is a huge congeries of interdependent societies How are their respective needs regulated, their freedoms protected and their manoeuvers timed? Experimental embryologists have begun to explore and discover the machinery of regulation. We know enough to realize that it will take many generations of investigators to work over the great and new field which is thus opening up When this is done we shall be in a better position to discuss the cause of "Variation" and the machinery of evolution

If we know only a little concerning the system of government which prevails in the developing embryo we can claim that the system which prevails in the growing body, as it passes from infancy to maturity, is becoming better known to us every year The influence of the sex glands on the growth of the body has been known since ancient times, their removal in youth leads to a transformation in the growth of every part of the body, altering at the same time the reactions and temperament of the brain In more recent years medical men have observed that characteristic alterations in the appearance and constitution of the human body can be produced by the action of other glands—the pituitary, thyroid, parathyroid and adrenals Under the disorderly action of one or other of these glands individuals may, in the course of a few years, take on so changed an appearance that the differences between them and their fellows become as great as, or even greater than, those which separate one race of mankind from another The physical characters which are thus altered are just those which mark one race off from another How such effects are produced we did not know until 1904, when the late Professor E H Starling, a leader amongst the great physiologists of our time, laid bare an ancient and fundamental law in the living animal body—his law of hormones I have pictured the body of a growing child as an immense society made up of myriads of microscopic living units, ever increasing in numbers One of the ways—probably the oldest and most important way—in which the activities of the communities of the body are coordinated and regulated is by the postal system discovered by Starling, wherein the missives are hormones—chemical substances in ultra-microscopic amounts, despatched from one community to another in the circulating blood Clearly the discovery of this ancient and intricate system opens up fresh vistas to the student of man's evolution How Darwin would have welcomed this discovery! It would have given him a rational explanation to so many of his unsolved puzzles, including that of "correlated variations" Nor can I in this connection forbear to mention the name of one who presided so ably over the affairs of this association fifteen years ago—Sir E Sharpey-Schafer He was the pioneer who opened up this field of investigation and has done more than anyone to place our knowledge of the nature and action of the glands of internal secretion on a precise basis of experimental observation With such sources of knowledge being ever extended and others of great importance, such as the study of heredity, which have been left unmentioned, we are justified in the hope that man will be able in due time not only to write his own history but to explain how and why events took the course they did

In a brief hour I have attempted to answer a question of momentous importance to all of us—What is man's origin? Was Darwin right when he said that man, under the action of biological forces which can be observed and measured, has been raised from a place amongst anthropoid apes to that which he now occupies? The answer is yes! and in returning this verdict I speak but as foreman of the jury—a jury which has been empanelled from men who have devoted a lifetime to weighing the evidence To the best of my ability I have avoided, in laying before you the

evidence on which our verdict was found, the rôle of special pleader, being content to follow Darwin's own example—Let the truth speak for itself

Arthur Keith

EDWARD BRADFORD TITCHENER

The recent death of Professor Edward Bradford Titchener, of Cornell, at the age of sixty, removes one of the most prominent figures in American psychology Professor Titchener came to this country in 1892, when experimental methods were first beginning to find favor and psychological laboratories were being started in all our leading universities An Englishman by birth, and a graduate of Brasenose College, Oxford, he studied under Wundt at Leipzig, and had just obtained his doctor's degree when called to Cornell

On assuming this position Professor Titchener at once adopted a program which has been followed at Cornell ever since He established a psychological laboratory and made experimental psychology the keystone of the departmental courses Under his direction, Cornell soon became one of the most productive universities in psychological research Many of our leading investigators owe their training to Titchener, and the Cornell laboratory has served as model for many departments elsewhere

While not following Wundt's system in every particular, Professor Titchener held rigidly to the Leipzig ideals Psychology meant to him introspection by trained subjects or observers, under carefully controlled conditions, with exact measurement of the stimuli and of the observer's responsive activities He had no sympathy with the behavioristic type of psychology which has grown up in the past fifteen years For Titchener psychology was the investigation of consciousness—of conscious, subjective experiences He measured "responses" as a means of obtaining quantitative values for the introspective data; but he did not consider the study of behavior as part of the science of psychology He set himself the task of analyzing the elementary data of experience—the structure of mind or consciousness—and pursued this analysis systematically throughout his career. The achievements of the Cornell laboratory in this direction are universally recognized by psychologists of every school No one has challenged the thoroughness nor the scientific accuracy of this work, though certain behaviorists have queried the value of introspective results as contributions to science The time has not yet come to pass judgment on this question But the title of Professor Titchener to rank as leader in the analytic or structural investigation of psychology is unassailable For many years this method and system have been generally known as the Titchenerian psychology

Titchener's writings are numerous and were always carefully prepared. He is the author of several textbooks on general psychology, both elementary and advanced, the best known being his "Text-book of Psychology" published in 1910 His most important contribution is his "Experimental Psychology," a comprehensive laboratory manual in four volumes (1901–05). Among his works on special topics may be mentioned the "Elementary Psychology of Feeling and Attention" (1908) and "Experimental Psychology of the Thought Processes" (1909) No less important are his editorial contributions For many years he served as American editor of the English magazine *Mind* (1894–1920), for a time the sole mouthpiece of psychology in Britain Since 1895 he has been closely identified with *The American Journal of Psychology*, first as associate editor under Stanley Hall (1895–1920), and after Hall's retirement as editor-in-chief (1921–25) To this and other journals he was a frequent contributor of systematic articles, experimental reports, discussions and reviews The wide range of his contributions is no less remarkable than his clear style and the breadth of his knowledge

Professor Titchener was an omnivorous reader in the field of psychology His acquaintance with the older writers extended to medieval and ancient times. He would frequently refer quite incidentally to contributions or hints in some classic source bearing upon a topic on which he or another was working At the same time he kept fully abreast with current literature One could not mention in his presence any recent periodical article, however trivial, that he did not show himself perfectly familiar with its contents

Nor were his interests confined to psychology He devoted much time to the kindred science of anthropology, and had gathered a large collection of idols, masks, drums and other folk-relics More recently he developed an interest in numismatics In connection with this latter avocation he undertook the study of several new languages, including Arabic and Chinese. He was highly appreciative of art in all its forms, particularly music For a time he served as "professor in charge of music" at Cornell

In his own field, psychology, there seems to have been a constant conflict between his broad general outlook and his narrower ideals Professor Titchener's aim was to concentrate the entire research work of his department upon certain definite problems, one topic being taken up at a time, and leading eventually and logically to the next. He was averse to investigation along independent lines by his students and to discussion of extraneous problems in the courses in his department.

This rigid specialization is to-day somewhat exceptional In most American universities the ideal is to teach a science rather than a system or school At Cornell the aim was to teach and develop a single type of psychology This policy has its advantages and disadvantages, both of which have been clearly shown at Cornell We find on the one hand a splendid body of experimentally obtained contributions to science—on the other hand an increasing lack of sympathy with non-introspective methods of investigation and with the important psychological problems which they suggest

The same characteristic appears in Titchener's personality Like Wundt, he preferred to work alone, it was difficult for him to cooperate He seldom attended the meetings of the American Psychological Association, and for many years withdrew from membership On the other hand, with his own pupils and his immediate circle of friends he was unreserved and genial One could always count on him for advice and sympathy Many years ago he brought together a small group of experimentalists and graduate students from various universities, who were accustomed to meet at various places during the spring recess, to discuss laboratory problems informally and give mutual advice. In these gatherings Titchener ignored all distinctions of age and degree, and treated every one on terms of close intimacy

The contrast between these two sides of his personality is after all not difficult to understand Titchener was wholly wrapped up in his work He had no time to devote to miscellaneous social activities, nor to general meetings, where a large proportion of the papers were quite foreign to his own line of research But his friends and coworkers were part of his scientific environment, and their interests were closely related to his own His punctiliousness in certain directions was often misunderstood by those who did not know him and gained for him the reputation of being "difficult" His friends understood him better. They knew that at heart he was sympathetic and thoroughly human, unbending only in matters which seemed to affect his scientific ideals and his standards of conduct. Thoroughly sincere himself, he was deeply offended at anything which seemed to savor of scientific dishonesty. Difference of standpoint had little effect on his friendships, but he was touched to the quick when these differences seemed to result in a lowering of scientific ideals. This distress he covered with a defense reaction of harshness, which was frequently misinterpreted.

It is difficult to estimate at this time Titchener's real place in the development of psychology. But one may safely predict that the value of his extensive experimental contributions will be fully recognized, whatever direction the science may take in the future. It is to be hoped also that Titchener's real personality, the underlying humanity and honesty of the man, may come to be more widely known and appreciated, and that his strict adherence to scientific ideals may have a lasting influence

Howard C Warren

Princeton University

SCIENTIFIC EVENTS

MESSAGE FROM THE RETIRING PRESIDENT OF THE BRITISH ASSOCIATION

The following message from the Prince of Wales, on laying down the presidency of the association, was read at the opening session of the Leeds meeting on August 31

My year of office as president of the British Association has come to an end, and I can only express my regret to the members of the association, and to our hosts, the City and University of Leeds, that I am unable to attend personally in order to take my leave

At Oxford last year I ventured in my address to lay before the meeting a view of the relations between science and the state I felt subsequently some justification for having chosen this topic, when I observed in the proceedings of the Imperial and Colonial Conferences of the past year the extraordinary emphasis laid upon the value of scientific research in relation to imperial development Both conferences set up special committees on research, and we can not but believe and rejoice that the foundations of an imperial scientific service are being firmly laid The prime minister of Australia indicated "the application of science both to our primary and secondary industries" as "the most important thing for empire trade"; more recently our ex president, the Earl of Balfour, invited the attention of the House of Lords to "the enormous value of the work given by men of science, with the most lavish generosity," to the study of problems of the common welfare

Such events as these place it beyond doubt that one of the main objects of the British Association itself is in process of achievement, namely, that of "obtaining more general attention for the objects of science" The association, the so called parliament of science, is one of the chief instruments to that end, and I trust that the public support will continue, in increasing measure, to be accorded to its work. Its powers, I am happy to say, have been very materially strengthened, during my own term of office, through the splendid generosity of Sir Alfred Yarrow, in making a gift of £10,000 for the general purposes of the association, to be expended, in accordance with his wise provision, in the course of twenty years. I gladly take this opportunity of publicly repeating the thanks of the association to Sir Alfred Yarrow.

In resigning the chair to Sir Arthur Keith, I can wholeheartedly congratulate the association on its choice of my successor. His name stands very high in the science of

man's origin and early biological history I have reason to believe that when any one in this country digs up a bone his first instinct (subject to the intervention of the police) is to send it to Sir Arthur Keith. You are to hear from him an address on Darwinism as it stands to day—a subject of perennial interest, and more than once one of warm controversy at our own meetings The occasion of the presidential address does not (I am thankful to say) lend itself to controversy, but the warmth I am sure you will supply in your welcome to Sir Arthur Keith, and, meeting as you are in Leeds, that warmth will be increased by the traditional quality of Yorkshire hospitality.

THE FIFTH INTERNATIONAL GENETICS CONGRESS

As has already been recorded here, the Fifth International Genetics Congress will be held in Berlin from September 11 to 17, with headquarters at the University of Berlin The general program will begin with a visit to the Zoological Gardens at five o'clock on Sunday afternoon and a reception at seven at the restaurant in the gardens Following is the program of general sessions for the week

Monday, September 12—Opening session (Address of welcome, Election of the Presiding Committee) Address R v Wettstein, Vienna Das Problem der Evolution Evening Informal reception by the Reichsregierung and the Preussische Staatsregierung

Tuesday, September 13—General meeting Addresses by R Pearl, Baltimore Eugenics, O Rosenberg, Stockholm Speziesbildung mit Vervielfältigung von Chromosomen, and H Federley, Helsingfors Chromosomenverhältnisse bei Mischlingen. Evening Reception by the Municipal Government of Berlin, in the Rathaus

Wednesday, September 14—General meeting Addresses by A Pézard, Paris Hormones sexuelles et hérédité mendélienne chez les Gallinacés, N I Vavilov, Leningrad Geographische Genzentren der kultivierten Pflanzen, and A F Blakeslee, Cold Spring Harbor Genetics of Datura Evening Special performances in the Staatlichen Opernhaus and the Städtischen Oper

Thursday, September 15—General meeting Addresses by C Correns, Dahlem Nichtmendelnde Vererbung, H J Muller, Austin The problem of genic modification, and H Winkler, Hamburg Zur Theorie der Crossing over-Erscheinungen Afternoon Visit to the institutes at Dahlem

Friday, September 16—General meeting Addresses by F A E Crew, Edinburgh Organization and function of an animal breeding research department, and J Seiler, Munchen Die Geschlechtschromosomenfrage Afternoon· Excursion to Potsdam and Sanssouci

Saturday, September 17—Business meeting to determine the next meeting place and to elect the committee for the preparation of the next congress Evening Closing dinner in the Zoologischer Garten.

Divisional meetings have been arranged as follows (1) General Genetics, with 57 papers, (2) Cytology and Genetics, with 20 papers, (3) Genetics of cultivated plants, with 16 papers, (4) Genetics of domestic animals, with 8 papers, (5) Human Genetics, with 15 papers, and (6) Eugenics, with 9 papers.

Americans contributing to the congress are Dr Chas B Davenport, Dr. E C. MacDowell, Dr M. Demerec, Dr A. M Banta and Dr Th R Wood, of Cold Spring Harbor, Professor H E Crampton and Dr L J Stadler, of Columbia University, Professor E M East, of Harvard University; Professor W. H Eyster, of the University of Maine, Professor E W Lindstrom, of Iowa State College, Professor F B. Hanson, of Washington University; Professor G H Shull, of Princeton University, Professor Charles Zeleny, of the University of Illinois, Professor R E Cleland, of Goucher College, Dr K Sax, of the Maine Agricultural Experiment Station; Professor N E Hansen, of the South Dakota College, Professor Leon J Cole, of the University of Wisconsin; Dr L C Dunn, of the Connecticut Agricultural College, Dr W S Anderson, of the University of Kentucky; Professor R E Clausen, of the University of California, Dr C J Lynch, of the Rockefeller Institute, Dr P W Whiting, of Boston, Dr O E White, of the Brooklyn Botanic Garden, Professor Raymond Pearl, of the Johns Hopkins University, Professor A F Blakeslee, of Cold Spring Harbor, Professor H J Muller, of the University of Texas

Several excursions of special interest to geneticists are planned at the conclusion of the congress.

THE AMERICAN CHEMICAL SOCIETY

THE American Chemical Society will hold its seventy-fourth meeting at Detroit, beginning on September 5.

The general program is as follows

Monday, September 5

10 00 A M.—Registration, Lobby of Ball Room, Statler Hotel.

2.00 P M—Council Meeting (continued in evening if necessary)

8:30 P M—Informal Reception and Dance

Tuesday, September 6

11.00 A M—General Meeting, Statler Hotel Ball Room.

Addresses of Welcome

In the name of the Detroit Section L W Rowe, Chairman, Detroit Section.

In the name of the City. Mayor John Smith.

Response·

George D Rosengarten, President, American Chemical Society.

1.30 P M—Ladies' trip to Bonstelle Playhouse.

2 00 P M—General Divisional Meetings.

Agricultural and Food, Biological, Chemistry of Medicinal Products, and Dye Divisions.

Industrial and Petroleum Divisions, Joint Symposium on "Chemistry Contribution to Automotive Transportation."
Physical and Inorganic Divisions, Symposium on "Present Status of the Chemistry of Proteins"
Organic Division—Small Banquet Room, Statler Hotel.
8 30 P M—Boat ride with special entertainment features.

Wednesday, September 7

9 30 A M—Divisional Meetings
1 30 P M—Ladies' Trip Luncheon and Bridge at Detroit Boat Club
2 00 P M—Divisional Meetings.
8 00 P M—Public Meeting and President's Address
Addresses
George D Rosengarten, President, American Chemical Society, "Reflections"
Charles F Kettering, "The Functions of Research"

Thursday, September 8

9 30 A M—Divisional Meetings
1.30 P M—Visits to Manufacturing Plants Trip (1) Ford, River Rouge, Trip (2) Ford, Highland Park, Trip (3) Sight seeing
2 00 P M—Golf Tournament
6 30 P M—Group Dinners.
9 00 P M—Special Feature Entertainment

Friday, September 9

8 00 A M—Visits to Manufacturing Plants. Trip (4) Parke, Davis & Co, Trip (5) U S Rubber Co, Trip (6) Acme White Lead and Color Works
9.30 A M—Divisional Meetings (if scheduled)
11 00 A M—Trip (7) Ann Arbor
2·00 P M—Trip (8) Dodge Brothers Motor Car Co, Trip (9) Packard Motor Car Co, Trip (10) Cadillac Motor Car Co

Saturday, September 10

There are many interesting boat, interurban car, bus, auto or airplane rides for those who have the time and inclination.

SCIENTIFIC NOTES AND NEWS

DR. W. B CANNON, of the Harvard Medical School, has been made chairman of the committee of arrangements for the International Physiological Congress to be held in Boston in 1929

DR. FRIDTJOF NANSEN, professor of oceanography in the University of Oslo, has been elected a corresponding member of the Prussian Academy of Sciences in the section of mathematical physics

DR. C. CORRENS, director of the Kaiser-Wilhelm Institute for Biology, has been elected an honorary member of the Botanical Society of Tokyo

THE Russian Academy of Sciences has elected as a corresponding member Professor James Franck, of the University of Gottingen, as recipient of the Nobel prize in physics. Professor Albert Einstein and Professor Walther Nernst, of Berlin, who were already corresponding members, have been elected honorary members.

HONORARY doctorates have been conferred by the University of Innsbruck on Dr Heinrich Herkner, Dr Karl Heider and Dr Albrecht Penck, all of the University of Berlin

THE Ling Foundation of Los Angeles has awarded a gold medal to Dr Michael S Creamer for work in behalf of the health of the school children of southern California The Ling Foundation was recently organized to forward child health work in southern California.

GEORGE HIGGINS MOSES, United States Senator from New Hampshire, has been made chairman of a special committee authorized by the 1927 Legislature to investigate the feasibility of improving marsh lands at Hampton and to find a remedy for coast erosion

DR F G COTTRELL, who since September, 1922, has been director of the Fixed Nitrogen Research Laboratory, will continue in charge of this work as chief of fertilizer and nitrogen fixation investigations in the new Bureau of Chemistry and Soils In addition to fixed nitrogen, this unit will include phosphoric acid, potash and fertilizer investigations being made at the Arlington Experiment Farm

DR F A ERNST, acting chief of the fertilizer and nitrogen fixation investigations and for some time a member of the Fixed Nitrogen Research Laboratory staff, has resigned to join the engineering staff of the Atmospheric Nitrogen Corporation

DR HOWARD R MOORE, formerly with the Eastman Kodak Company, has been appointed to the staff of the Cryogenic Laboratory of the Bureau of Standards

WILLIAM HENRY PATCHELL, British consulting engineer and past-president of the Institution of Mechanical Engineers of Great Britain, recently arrived in the United States Mr. Patchell acts in the capacity of consulting engineer for a number of American public utilities

DR W. A SETCHELL, of the University of California, has returned from a tour around the world He made a special study of coral reef formation among the islands of the Pacific for a period of four months, and also made a survey of varieties of subantarctic algae A number of valuable collections made during the trip will be housed in the department of botany.

DR R M WENLEY, who has been acting as director of the British Division of the American University Union, returns next month to the headship of the department of philosophy and psychology in the University of Michigan

DR. J B AUSTIN, of Yale University, as a guest of Cryogenic Laboratory of the Bureau of Standards, has been engaged in an investigation of the ultra-violet absorption spectra of toluene and the three xylenes at low temperature.

FRANK REEVES has been granted leave from the U S Geological Survey for four months to do commercial work in petroleum geology in Canada

Two series of colloquia will be given at the University of Wisconsin summer meeting of the American Mathematical Society and the Mathematical Association of America, held during the week of September 5 Professor Anna Pell-Wheeler, of Bryn Mawr College, will lecture on "The Theory of Quadratic Forms in Infinitely many Variables and Applications." Professor E. T Bell, of California Institute of Technology, will lecture on "Algebraic Arithmetic"

LOUIS A FUERTES, distinguished as a naturalist and artist, lecturer at Cornell University, was killed in an automobile accident on August 21 Mr Fuertes was born in Ithaca, New York, on February 7, 1874.

PROFESSOR LIONEL REMOND LENOX, for thirty-five years a member of the faculty in chemistry at Stanford University, died on July 25, aged sixty-two years

JOHN HENRY REYNOLDS, formerly dean of the faculty of technology of the University of Manchester, died on July 17, at the age of eighty-five years

C W DANIELS, formerly director of the London School of Tropical Medicine, died on August 6, aged sixty-five years

PROFESSOR ALEXANDER BACKHAUS, formerly director of the Agricultural Institute of the University of Konigsberg, has died at the age of sixty-one years

A NEW episcope has been installed at the Royal Society of Medicine, London, as part of the memorial to the late secretary, Sir John MacAlister. The instrument has been constructed in Germany by Carl Zeiss, according to the specifications of the committee in charge of the memorial, on whose behalf the secretary of the society, Mr G R Edwards, accompanied by the operator, made a special journey to Jena and spent four days in the Zeiss workshops conferring with experts of the firm.

MEMORIAL HOSPITAL, New York City, an institution for the study and treatment of cancer and allied diseases, has received $25,000, or $5,000 a year for five years, from Lucius N. Littauer, of Gloversville, N. Y., to defray the cost of special research in chemo-therapy; $5,000 from Mrs. S. M Gibbons, of New York, to finance the study of the "gross clinical cases of cancer," and $2,500 from Daniel Guggenheim, of New York, for special research on the effects of radioactivity on certain parts of the body It will be remembered that Memorial Hospital received recently for the enlargement of its work $60,000 a year for five years from Mr John D Rockefeller, Jr, and $250,000 for the purchase of radium from Mr Harkness

THE fourth International Congress of Theoretical and Applied Limnology will be held in Rome this year, and a full program has been arranged covering the period from September 18 to October 3 From *Nature* we learn that the congress will be divided into four sections, dealing with physics and chemistry, geology and hydrography, biology, and applied limnology, respectively The first week will be spent in Rome, during which time lectures and papers will be given and opportunity will be afforded for visiting the Limnological Exhibition, the Royal Central Laboratory of Hydrobiology, the Royal Fish Breeding Establishment and the Zoological Gardens Receptions will also be given on the Capitol and at the Royal Italian Geographical Society Two days will be spent at Naples, where the visitors will be received at the zoological station and at the university The congress will conclude with an itinerary to the Hydrobiological Stations on Lakes Garda, Como and Maggiore, while nights can be spent *en route* at Perugia, Verona and Milan The congress will end on Monday, October 3, at Lake Maggiore.

The Archivio di storia della scienza, which was started in 1919 for the history of science under the editorship of Aldo Mieli, of Rome, is now being enlarged and issued as an international journal, in which articles appear in the Italian, English, French or German language Twenty-seven foreign editorial collaborators have been chosen The two thus far representing the United States are Florian Cajori, of the University of California, and Edgar F Smith, of the University of Pennsylvania.

IN the development of the Blandy Experimental Farm of the University of Virginia, which was bequeathed to the university by the late Graham F Blandy, the appointment has been recently announced of Dr Orland E. White, curator of plant breeding and economic plants at the Brooklyn Botanic Garden, as professor of agricultural biology and director of the farm. *The Experiment Station Record* reports that five research fellowships have been established,

two of $1,000 each and three of $500 each, to which graduates from standard colleges who have majored in biology or agriculture will be eligible. Appointees are expected to register in the graduate department of the university and take work leading toward a higher degree

THE U S Public Health Service has called attention to the unusual prevalence of poliomyelitis. Reports from eight states disclosed the presence of 192 cases of this disease for the week ended August 6 Incomplete reports from 34 other states showed only 42 cases For the week ending August 6, California reported 56 cases, Connecticut, 11, Massachusetts, 10, Missouri, 15, New Jersey, 17, New Mexico, 9, Oklahoma, 3, Texas, 10 For the corresponding week of last year, 38 states reported only 66 cases

The South African Mining and Engineering Journal contains notice of the discovery by H R Adam, of a new palladium mineral from the Tweefontein workings, having the apparent formula Pd_3Sb The mineral contains practically no platinum, and the sperrylite $PtAs_2$, found in the same locality, is free from palladium These two minerals represent the only compounds of the two metals found in nature

RICHARD M SUTTON, of the Norman Bridge Laboratory of the California Institute of Technology, writes "At 8 40 on the evening of July 25, while riding through the San Joaquin Valley near Merced, my attention was attracted by a brilliant meteor falling toward the south As it approached the earth it suddenly broke into two pieces of nearly equal intensity, whose paths diverged at an angle of 30° from each other After continuing their flight for about one second longer, they were both extinguished at approximately the same time"

DR. T D A. COCKERELL writes to SCIENCE as follows. "We reached Leningrad July 10 on the Russian steamer *Soviet*, having three days at Bremen on the way We had three days in Leningrad and saw the principal scientific establishments The museum of the Academy of Sciences is magnificently full of important things, all excellently arranged. We found the entomological collections very extensive and in very good order We saw the famous mammoth, with hair on it, dug out of the ice in Siberia, also the last meal from its stomach The academy collections came quite safely through the revolution, thanks especially to Professor Karpinsky The Botanic Garden is very fine; we were shown everything by Professor Komaroff, well known for his studies of the Asiatic flora. The great building and extensive operations of the geological committee astonished us. Here we saw the duck-billed dinosaur found on the Ameer, very like Canadian forms. On the way here we had part of a day in Moscow, where we were taken about by Professor D Itovaisky, well known for his work on ammonites At Irkutsk we are comfortably placed in the guest-room of the Geological Committee We have already been to Ust Balei for fossil insects, and have made good collections of recent insects Tomorrow we expect to go to Lake Baikal We have seen a great deal of Professor W Schewiakoff of the university here His work on radiolaria is, I presume, much the best ever done on that group The university here, though only a few years old, is already an important institution, and supports a research laboratory on Lake Baikal We are the first Americans to see it in its developed condition, and to see Professor Schewiakoff's very beautiful preparations showing the anatomy of various animals Every one without exception has been very kind to us There is a general desire for more intercourse with America"

THE American Ceramic Society is sponsoring a foreign trip in 1928 The tour has been built around European ceramic centers such as Stoke-on-Trent and the "Potteries" in England, Delft in Holland, Meissen in Germany, Prague in Czecho-Slovakia and Paris in France

THE annual inspection by the General Board of the British National Physical Laboratory at Teddington took place on June 24 Over 1,000 visitors were conducted over the extensive buildings, and a keen interest was shown in the progress of the various departments where the staff were engaged carrying out their work of research and experiment The visitors were received by Sir Ernest Rutherford, president of the Royal Society and chairman of the board, Sir Richard Glazebrook, chairman of the executive committee, and Sir Joseph Petavel. In the aerodynamics department special attention was centered on the Cierva autogyro, which was described as a wingless aeroplane In the engineering department instruments for measuring and recording the vertical and horizontal disturbances of the ground due to traffic received much attention These instruments have been designed and constructed at the laboratory primarily for the measurement of ground disturbances due to road and rail traffic Particularly interesting was a working model of a motor-car showing the action of the front and back brakes It revealed that the sudden application of the back brake made the vehicle swerve to one side or the other, while the application of the front brake only made the car skid straight on. Interesting experiments were also witnessed in the metallurgy and physics departments.

IT is announced in *Nature* that the British Secretary of State for the Colonies has appointed a committee "to formulate practical proposals for submission to the Colonial Governments to give effect to the resolution for the Colonial Office Conference on the subject of Colonial Agricultural Scientific and Research Services" These proposals are to "include a scheme, based on contributions to a common pool, for the creation of a Colonial Agricultural Scientific and Research Service available for the requirements of the whole Colonial Empire for the support of institutions needed for that purpose, and for the increase of research and study facilities in connection with specialist services of the Colonies generally" The committee is thus constituted Lord Lovat, Parliamentary Under-Secretary of State for Dominion Affairs (chairman), Mr W. Ormsby-Gore, Parliamentary Under-Secretary of State for the Colonies, Sir Graeme Thomson, Governor of Nigeria, Mr A. S Jelf, Colonial Secretary, Jamaica, Mr O G R Williams, Assistant Secretary, Colonial Office, Major R D Furse, Private Secretary (Appointments) to the Secretary of State for the Colonies, Sir J B Farmer, Dr A W Hill, Mr F L Engledow, and Dr A T Stanton, Chief Medical Adviser to the Secretary of State for the Colonies

THE *British Royal Geographical Journal* reports that the Italian National Committee for Geography has decided to promote the creation of a fund for studies in Palestine, which will be devoted mainly to geographical research, whereas the scope of similar institutions which have existed for many years in other countries has been mainly historical and archeological In accordance with this purpose, the first work to be undertaken by the Italian fund will be an expedition to chart the Dead Sea on a fairly large scale and to map the adjoining portion of the depression in which it lies and of the Jordan trough In addition to the hydrography and mapping a geological survey and various limnological researches will be carried out It is also planned to establish a station on the Dead Sea shores for protracted observation of variations in the sea-level and of the meteorological conditions of the basin

UNIVERSITY AND EDUCATIONAL NOTES

THE will of Elbert H Gary, chairman of the board of the United States Steel Corporation, includes bequests for scholarship funds of $50,000 each to McKendree College, the University of Pittsburgh, Lafayette College, Trinity College, Lincoln Memorial University, Syracuse University, Northwestern University and New York University.

THE campaign to raise $1,000,000 for the Medical School of Howard University, Washington, has been brought to a successful conclusion Negroes contributed $150,259 to the campaign. A tablet bearing the names of fifty-one Negroes whose donations ranged from $1,000 to $10,000 will be placed in the new medical school building

AT a meeting of the board of trustees of Ohio State University, on August 4, Dr John H J Upham, Columbus, was appointed acting dean of the Ohio State University College of Medicine Dr Eugene F McCampbell, who was formerly dean, retired on July 1

DR ALBERT WARREN STEARNS has been appointed dean of Tufts College Medical School, Boston, and will take up his new work on September 1, succeeding Dr Stephen Rushmore

DR F M BALDWIN, who for the past ten years has been in charge of physiology at Iowa State College at Ames, has resigned his professorship to take charge of the department of physiology and become director of experimental marine biology in the University of Southern California at Los Angeles

M N SHORT, of the U S Geological Survey, has been appointed lecturer in mining geology at Harvard University during the absence of Professor Graton on his sabbatical year

DR O H ELMER, assistant plant pathologist at the Iowa Agricultural Experiment Station, has been appointed to succeed Dr R P White as assistant professor of botany and assistant plant pathologist at the Kansas College and Experiment Station

D S MASTERS, of Ohio State University, has been appointed instructor in chemistry and chemical engineering at Washington University, St Louis, Mo.

DR. J H ASHWORTH, of the University of Edinburgh, has been transferred from the chair of zoology to the chair of natural history.

DISCUSSION AND CORRESPONDENCE

THE "WASHBOARD" OR "CORDUROY" EFFECT DUE TO TRAVEL OF AUTOMOBILES OVER DIRT ROADS

THE writer returned recently from a somewhat extended trip by motor car in the Mojave desert, where much of the mileage was over unpaved roads. Of these, two types were noted, first, primitive desert road, which winds among sage and cactus over the long gently sloping alluvial washes characteristic of this desert, apparently following the trail of the first wagon or automobile to mark the way, and second, the worked dirt roads mainly traveled.

The first type, particularly serving as feeders for

ranches lying some miles off the highway, consists mostly of the two ruts of the wheels, usually sandy and gravelly, underlain by more compact, or solid material. In this type of unpaved road the "washboard" effect to be described was not observed to a very appreciable extent It is surprising how rapidly automobiles can be driven on such roads by drivers accustomed to them, with the many turns, which in places are quite abrupt, and with the necessity of keeping in the ruts As much as a fifty-mile rate has been averaged on such a road, according to reliable information With the continued twisting of the road the driver must continually watch details of the steering, so as not to let the wheels cut into the sand and gravel of the walls of the ruts The driver unaccustomed to this type of road tends to turn his steering-wheel too soon in approaching a turn, causing departure from the ruts, whereas the trick is to let the wheels ride the ruts clear to their turning, and to turn with them Of course much of the success of rapid driving under these conditions is in knowing from experience the details of the road, such as the curvature of each turn, its total angle, and where the straighter stretches are located that will permit speeding

On the other type of dirt road, graded and occasionally dragged, the "washboard" phenomenon was found frequently It may be familiar to drivers on dirt roads everywhere. A stretch of road well illustrating it at intervals is that between Daggett and Needles on the much-traveled National Old Trails Highway (Santa Fé Route). The usual road surface on this stretch is a rather thin layer of loose sand and gravel, or small fragments of broken rock, lying on more compact material as base The phenomenon consists in the heaping up, by the tires of the automobiles themselves, of this loose material into parallel ridges, an inch or so in height, crossing the road at right angles, often with a slight sinuosity. The ridges have a quite uniform spacing of one and one half feet, very roughly, and are found in groups of six or eight, or more A remarkable fact about them is that while as a group they appear to have grown in the direction of the road, as though they were the effect of sheets of water flowing along on the road, their growth has been essentially across the road, and is the result of the passing of many machines in both directions.

A reasonable explanation of the "washboard" roads ("corduroy," they are sometimes called, from a similarity to the old time roads where logs were laid transversely to make a safe passage for vehicles on soft ground) would seem to be as follows· Given, a somewhat shallow and uniform layer of loose sand and gravel on a fairly flat, hard surface, and a local inequality, say a fair-sized rock, or a chuck-hole in the solid base, which imparts a sudden upward impulse to one or both of the front wheels of the first automobile to encounter it. Consider one of the front wheels as experiencing this bounce. The physical quantities involved are (1) the elasticity both of the tire and of the spring, and (2) the inertia of the wheel system as distinct from that of the much heavier body The necessary conditions are thus present for vibrations If the automobile is supposed to be traveling at a speed of 35 or 40 miles per hour, the body of the car, on account of its far greater inertia, may be assumed to undergo at the time of the bounce a vertical displacement which is relatively negligible With a given elasticity in the system the particular wheel mentioned will have a definite period of vertical vibration relative to the approximately non-displaced body Thus it will vibrate for an appreciable time after the initial shock, and each time it moves away from the body of the car it will squeeze out before and behind it on the road some of the loose material, and in this way leave a series of equally spaced low ridges and shallow depressions It is conceivable that a sympathetic effect would at the same time be transmitted to the other front wheel, which also would then tend to produce a similar effect on the loose material over which it passes There must follow similar action on the part of the rear wheels The question arises as to how the natural frequency of the front wheels, with respect to the body of the car, compares with that of the rear wheels The two periods must be comparable, otherwise the rear wheels would tend to undo the work of the front ones, with the result that the well-defined washboard effect would not perpetuate itself

An explanation offered by a driver living in the desert, of the phenomenon, was that the wheel, at the first bounce, because of lowered resistance between tire and road resulting from the diminished pressure between them, actually "spins," and in doing so kicks some of the loose material backward, repeating this action a number of times as the bouncing, that is, the vibration, continues This explanation would require, at any rate after the group of ridges is once established, that the diminished pressure occur when the wheel is nearest the more compact sub-surface of the road, if the ridges are to perpetuate themselves in positions approximately fixed, so that the pressure should then be greater on the ridge than in the depression This greater pressure on the loose material of the ridge would then be expected to show a tendency toward flattening it out, undoing the effect of the wheel while "spinning" in the depression. However, if the wheel slips

periodically at the depressions but not at the ridges, then for a constant speed of the car body forward over the road, and thus presumably of the axle also (neglecting any vibration lengthwise of the road, of the wheels relative to the body) a constant rate of rotation of the wheels would be consistent with this explanation For in ascending and descending the ridges the periphery of the tire at the point of contact would be moving at an angle with the direction of the forward motion of the axle, and if there were no slipping anywhere, would have to be moving circumferentially around the axle at a rate greater than that necessary in the depressions But by the same argument there would be a tendency to spin on the peaks of the ridges also, which would tend to wear them down This explanation by slippage uses, to be sure, the natural rate of vibration of the wheels relative to the approximately stationary body of the automobile But on its face it does not appear so acceptable as that attributing the ridges entirely, or almost so, to the simple, periodic bumping of the road by the wheels, with negligible periodic slip

The problem more generally, and in its simplest form, is that of a vibrating system of two masses, one much greater than the other, connected by an elastic spring, and affected by an elastic push corresponding to that of the rubber tire, and by gravity

As to the transverse growth of the ridges, whose individual identity as they lie across the road, can be recognized often over a length of ten or twelve feet, possibly more, suppose a second car, similar to the first, follows it and strikes the first humps formed, which will be necessarily short transversely to the road The chances are that the wheel of the second car will not strike the humps squarely if at all, but at one end of them or the other. But this is sufficient to give an initial bounce, and the result is a slight lengthening, transverse to the road, of the initial humps It is rather remarkable that the two series of humps, one at either side of the first car to pass, should eventually join up into continuous ridges across the road, but this is the actual effect from the passing of many cars Perhaps this joining up is the result mainly of a sympathetic action, mentioned above, of the wheel on the opposite side of the machine

Alternate grooves and ridges, roughly parallel, can be formed by water flowing across the road, but this type is likely to lie obliquely rather than perpendicularly with respect to the road, and at any rate will hardly be so uniformly spaced over a considerable distance The opinion may be ventured that where ridges of the particular washboard type are found on solid road surface devoid of loose material, they were formed by the vibration process at a time when the ground, due probably to moisture, was in a more pliable condition

The frequency of vibration of the wheels of a car relative to a stationary body is a quantity much greater than the frequency of the heavier body relative to stationary wheels Assuming one and one half feet as the approximately uniform interval between the ridges of the "washboard," and further assuming 30 miles per hour as the speed of the "average" car, the average vibration rate of the wheels relative to the body of the car, comes out about 30 v p s ($v = \lambda$ The value of one and one half feet as the distance between ridges in a group makes the vibration rate about 2 per cent less than the speed of the automobile in miles per hour) A certain driver, who has driven much on these desert roads, mentioned 25 miles as an average value for all machines, which would give approximately 25 v p s for an average value.

The question might be raised whether the "average" car, or a particular class of cars, heavy or light, is in the main responsible for the ridges Also, is the vibration chiefly that of the balloon tires? Heavier cars with balloon tires were observed to travel in the straight stretches at 40 miles and better Riders in the heavier machines traveling at the higher speeds are probably little disturbed by these corrugations on the road The bumping effect in a lighter car at a speed of 12 or 15 miles would become at times monotonous, to say the least A certain other driver living in the desert stated he found the bumping effect least at a speed of about 35 miles This should vary with the type of automobile, but theoretically for each car there is one best speed for maximum comfort of riding, and that is the speed at which the wheels "resonate" with the ridges

The writer has taken no actual measurements on these ridges. Moreover, it would be interesting to check the vibration rates of automobile wheels in the laboratory, with the values calculated on the basis of the physical explanation offered. Such matters are properly subjects for consideration in the fields of road and automobile engineering

L. E. DODD

DEPARTMENT OF PHYSICS,
UNIVERSITY OF CALIFORNIA
AT LOS ANGELES, CALIF

THE REVERSIBLE MIXING OF SUBSTANCES IN THE CONDENSED STATE AT THE ABSOLUTE ZERO OF TEMPERATURE

THE thermodynamical results established in a previous paper[1] and extended in a subsequent paper[2]

[1] Read at the Philadelphia meeting of the American Association; SCIENCE, Feb. 25.

were further extended and applied in a paper read at the Washington meeting of the Physical Society An outline of a few of the more important results may be of interest to the readers of SCIENCE on account of their bearing on physico-chemical experiments frequently performed in a laboratory, and involving quantities often made the subject of accurate determinations

It is shown that the internal heat of mixing h_m, or the increase in internal energy on mixing a number of substances, is zero, or

$$h_m = O$$

at the absolute zero of temperature, if the substances and resultant mixture are under the pressures of their vapors It is also shown that

$$\frac{dh_m}{dT} = O$$

$$\text{and } \frac{d^2h_m}{dT^2} = O$$

where T denotes absolute temperature Hence if h_m can be expanded in powers of T by Taylor's Theorem

$$h_m = aT^3$$

near the absolute zero of temperature, where a is a constant. This result could be investigated experimentally without great difficulty It would involve measurements of the change in temperature on mixing a number of substances near the absolute zero of temperature, and a determination of the corresponding specific heats of the substances and the resultant mixture The quantities H_m and A are shown to possess similar properties, where H_m denotes the heat absorbed on reversibly mixing the substances and A the maximum work done during the process

In the first paper on the subject it was shown that the controllable internal energy and entropy, which are functions of the controllable variables v and T, are zero for any substance or mixture in the condensed state under their vapor pressures at the absolute zero of temperature If several substances are simultaneously considered another controllable operation becomes possible, namely that of mixing some of them From the way the foregoing result was established it does not follow directly that there will be no change in internal energy or entropy on mixing the substances under their vapor pressures at the absolute zero of temperature It is now shown that no change takes place. With this result as basis it is further shown that the well-known formulae

$$\Delta U = h_m$$

$$T \Delta S = \Delta U + A = h_m + A = H_m$$

$$\Delta U = T\left(\frac{\partial A}{\partial T}\right)_v - A$$

hold also if U and S represent the controllable internal energy and entropy respectively Since these quantities can be calculated from experimental data a method is afforded of testing the truth of the method of deduction of the various results obtained, and also of testing the truth of the first and second law of thermodynamics on which all the results are fundamentally based

R D KLEEMAN

SCHENECTADY, N Y

[1] Read at the New York meeting of the Physical Society; SCIENCE, April 29.

DOUBLE COVEY OF CALIFORNIA VALLEY QUAIL

IT is common knowledge that the males of many species of birds assist in the protection and care of the young birds During the week of June 12–18, the following interesting observations were made by Mr R A Holley, of Fillmore, California, on what was apparently a double covey of California Valley quail or partridge (*Lophortyx californicus vallicola* (Ridgw)) In the early part of the week he flushed a large flock of quail in an orchard The covey consisted of twenty-three young quail of two distinct sizes and two adult males, one of which had a crippled leg, but no adult females Approximately one half of the young quail were about one third grown, the rest were of uniform size but somewhat larger

The following day the same covey was seen again The crippled male was acting as sentinel while the other male was feeding with the young ones When the sentinel was approached the covey flew a short distance away. It was then noted that the crippled male had taken his place with the young on the ground and that the other male was acting as the sentinel from the fence post This same covey of two males, one a cripple, and the twenty-three young belonging to two size groups were seen on four successive days in the same orchard Apparently the females of the two adult pairs had been killed and the two males with their respective broods had joined forces This alliance had made it possible for the males to alternate as sentinels and warn the combined broods of any impending danger

R. M. SELLE

ZOOLOGICAL DEPARTMENT,
OCCIDENTAL COLLEGE,
LOS ANGELES, CALIF

SCIENTIFIC BOOKS

Man not a Machine. By E. RIGNANO London Kegan Paul, French, Trubner & Co., 1926 77 pp

IN this handy little volume Rignano discusses in a brief but suggestive way the mechanistic and the

vitalistic interpretations of life, especially of the life of man. The subject matter is considered under nine heads, such as metabolism, adaptation, behavior, instincts, mentality, social relations, and the like. The author concludes that in all nine aspects there is an irreducible residuum that can not be explained away on mechanistic grounds. This irreducible element, always present, is of a purposive character. Having thus shown the insufficiency of the mechanistic interpretation, Rignano concludes that a vitalistic interpretation of life is the only one tenable. To the reviewer this step seems to be a *non sequitur*, for in addition to vitalism and mechanism there are other possible ways of considering life, witness that embodied in emergent evolution. Thus the view of life from the standpoint of emergent evolution avoids the obvious limitations of the mechanistic conception and yet differs radically from vitalism. It may be, therefore, a much more truthful interpretation of life than either vitalism or mechanism. It is to be regretted that this aspect of the subject has not been discussed by Rignano, whose book, however, affords good reading, suggestive and stimulating.

G. H. PARKER

Traité de Geographie Physique par EMMANUEL DE MURTONNE, professeur à la Sorbonne. Tome troisième. Biographie (en collaboration avec A. CHEVALIER ET L. CUÉNOT). Un Vol. in 8°, 464 pages, 94 figures dans le texte, 24 photographies hors texte. Librairie Armand Colin, Paris.

THE first edition of the "Traité de Geographie Physique" appeared twenty years ago and a second edition later. The author has remodeled his work, which has now been published in a third edition. Volume III devoted to biogeography completes the work, and in it there are 404 pages of text, instead of 154 pages in the first edition, 94 figures in place of 62, and 25 pages of bibliography instead of 10 pages. The growing complexity of the subject, and the abundance of technical studies devoted to biogeography have been such as to necessitate the association of two other scientists. MM. Chevalier, director of the laboratory of colonial agronomy, and Cuénot, professor of zoology in the University of Nancy. The volume is a single complete treatise on biogeography and is based on current and recently pursued research on the subject. A chapter is devoted to general principles, as common to botanical and zoological geography.

Five chapters are devoted to phytogeography. One of them deals with the science of the soil, another to plant sociology, where are given in a detailed manner the most recent investigation of plant associations and their evolution. Another important chapter considers the influence of man on vegetation with an essay on the classification of the systems of cultivation.

Three chapters deal with zoogeography and are filled with matters of great interest to zoologists, such as the origin of species and their adaptation to diverse surroundings. For geographers, this book is a mine of information. It ought to appeal to agriculturists, economists, colonial experimenters and the public in general.

JOHN W. HARSHBERGER
UNIVERSITY OF PENNSYLVANIA

SCIENTIFIC APPARATUS AND LABORATORY METHODS

ACCURATELY TIMED INTERMITTENT LIGHTING

IN many types of biological work a dependable, home-made apparatus for providing accurately timed alternate periods of light and darkness is desirable. Commercial machines are generally so high priced as to be out of the question in small laboratories.

The apparatus here described, which has the advantage of cheapness, consists of a revolving drum on the surface of which are made contact and break surfaces. A thermograph is readily adapted to this purpose, as illustrated in figure 1. The thermograph is insulated

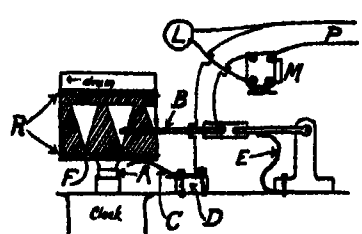

Fig. 1.

at A by a cone of fiber paper, and at the point D by fiber board. The lower end and the outer wall of the drum are brightened to make contact with B and C. Then a band of fiber paper F is held in place around the drum by two rubber bands R. Seven triangular pieces are cut from this band of fiber paper as shown in figure 1, to allow the point B to make contact with the drum. When this point comes in contact with the drum, the magnetic switch, No. 2829653Z2 General Electric, M closes the power circuit P, and the lights are on. As the point B runs onto the fiber paper breaking the control circuit the magnet is demagnetized, and the lights are turned off.

By simply raising or lowering the point *B*, by means of the adjustable support *E*, a long or short illumination period may be obtained. The drum is adjusted to the particular time of day requiring illumination, and the clock wound once each week.

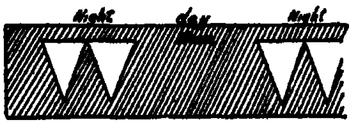

Fig 2.

If illumination is required for any length of time during two or more different periods of the day, the band of fiber paper is cut accordingly. Figure 2 represents the type of band for any length period of morning and evening illumination.

Dean A. Pack

Sugar Plant Investigations,
Bureau of Plant Industry,
U. S. Department of Agriculture,
Salt Lake City, Utah

CENTRIFUGING FILTERABLE VIRUSES

From time to time there have appeared experimental reports in which attempts to concentrate filterable viruses by the centrifugal method have been described. Particles of such small size are incapable of any great velocity of sedimentation even when acted upon by centrifugal force. In a general sense, the same is true of bacteria.

By Stoke's law, the velocity **v** of a sphere of radius *r* and of density Δ falling under gravitational acceleration g in a liquid of density δ and viscosity η is

$$v = \frac{2r^2g(\Delta - \delta)}{9\eta}$$

Substituting for g, gravitational acceleration, the centrifugal acceleration—

$$\omega^2R = 4\pi^2RP^2$$

where ω is angular acceleration, R is the radius of curvature (from the center of the centrifuge to the particle), and P is the angular velocity, or revolutions per second, we have.

$$v = \frac{2r^2(\Delta - \delta)}{9\eta}(4\pi^2RP^2) = \frac{8\pi^2r^2RP^2(\Delta - \delta)}{9\eta}$$

This, then, is the general equation.

Let us now solve for **v** in a general problem. We assume a virus particle 5×10^{-6} cm. in radius (0.1 μ diameter), spherical, of density 1.1[1]. Let it be suspended in a liquid of density 1.0 and located 20 cm from the center of the centrifuge. Let the viscosity be 0.01 (water at 20° C.) and the speed be 3,600 r.p.m. (P = 60). Then

$$v = \frac{8\pi^2(5 \times 10^{-6})^2 \times 20 \times 60^2(1.1 - 1.0)}{9 \times 0.01}$$
$$= 1.58 \times 10^{-4} \text{ cm./sec. or } 0.57 \text{ cm./hr.}$$

This velocity is certainly not great, since under the conditions stated some 8.8 hours of centrifuging would be necessary to carry a particle 5 cm. And if analysis is made of the values used in this problem it will be seen that they are taken to give **v** a probable maximum value. The viscosity in practice is ordinarily greater than that of water, and the radius of the particle is almost unquestionably less than 5×10^{-6} cm. Ordinarily centrifuge methods applied to filterable viruses are from the standpoint of physical laws of questionable value.

The surface-volume relationship in the illustration problem is such that a 1 cc. volume would have to be contained in a film less than a micron thick and over half a meter square to give relatively the surface exposure, considering both sides of the film. Or a centimeter cube with its 6 cm.^{2} surface would have to have a density about 1/100 that of air to give the same surface-mass relationship as pertains to the minute particle described.

Thanks are due to Mr. W. W. Sleator of the laboratory of physics of the University of Michigan for checking and correcting this problem.

M. S. Marshall,
Research Bacteriologist

Michigan Department of Health

[1] Investigation of a number of references on the density of bacteria gives various figures. A density of 1.1 is considered a fair average.

PERSIMMON SEEDS FOR CLASS USE

An examination of the seeds of the common persimmon, *Diospyros virginiana*, convinced the writer that they should make excellent class material for embryological studies as well as for studies of the structures of a thick-walled endosperm. The comparatively large, straight embryo is easily removed from the endosperm and its parts are easily seen. Younger stages should make good microscopic preparations for embryological work, provided that the difficulties encountered in cutting the testa and endosperm are not too great. Carbohydrate is apparently stored in the thick cell walls of the endosperm in the form of cellulose or hemi-cellulose, and this being the case, the germinating seeds should be a good source of cytase-like enzymes.

During the past season the writer sent a supply of persimmon seeds to Dr. E. M. Gilbert, of the department of botany of the University of Wisconsin, who writes that they have been used successfully in

several classes for embryological work and for studies of the thick-walled endosperm Dr Gilbert further states that the walls of the endosperm have proved to be unusually good material for the study of the plasmodesmus

V H YOUNG

DEPARTMENT OF PLANT PATHOLOGY,
UNIVERSITY OF ARKANSAS

SPECIAL ARTICLES

THE OCCURRENCE OF THE PLATINUM METALS

RECENTLY I have had the opportunity of studying the results of some forty analyses of the Canyon Diablo meteorite, both of the iron and of the so-called shale-balls The latter appear to be merely the oxidized iron, as some of them still have an unoxidized iron core The analyses were made by at least eight different analysts, including Dr J. W Mallet, H H Alexander, A H Phillips, G H. Clevenger and myself, and included the content in platinum, iridium and in some cases palladium

There have been but two references in literature to the occurrence of platinum in meteorites [1] Trottarelli reported palladium in the Collescipoli stone, and J M Davidson found the Coahuila iron to contain 39 parts per million of platinum and 2 44 parts iridium In the Toluca meteorite sufficient platinum was found to give a precipitate of potassium chloroplatinate, which from its color probably contained iridium No quantitative estimation was made

The Canyon Diablo analyses, weighted according to my best judgment, average as follows

Platinum	11 2 parts per million
Iridium	5 8 parts per million
Palladium	2 1 parts per million

The ratio of platinum to iron in the shale-balls corresponds closely to that in the unoxidized meteorite, the ratio of iridium to iron is lower and that of palladium to iron somewhat higher.

The average amount of nickel found in all the analyses, not weighted, is 6 44 per cent Clarke gives the average nickel for 318 meteorites as 8 52 per cent, and in the Ovifak iron 2 95 per cent

It may be considered probable that platinum, and doubtless all the platinum metals, would be found in all meteorites if analyses were made with this end in view, though the estimation of three or four tenths of an ounce of platinum and iridium to the ton of meteoric iron is no simple task It may be noted that in dissolving the iron in either sulfuric or in hydrochloric acid, some of the platinum and iridium will go into solution, and this doubtless accounts for the varying results on the Canyon Diablo iron where such a method has been used.

Attention has been called by many observers to the association of the metals of the eighth group in nature In 1891 Daubrée and Meunier noted the occurrence of metallic iron containing traces of platinum in the gold washings of Berazovsk in the Ural, and also that many meteorites resembled rocks with which platinum is generally associated in nature.

It may be worth while to attempt a rough approximation of the relative amount of the metals of the eighth group, assuming that the iron of the interior of the earth contains the same proportion of the platinum metals as the Canyon Diablo meteorite

For this we can use the calculation of F. W Clarke for the earth as a whole

Iron	67 2 per cent
Nickel	4 0 per cent
Cobalt	277 per cent

Average cobalt in 318 meteorites 0 59 per cent

Clarke gives the analyses of 8 native platinums and 3 iridosmiums, and Kemp gives 42 analyses of native platinum and 12 of iridosmium From these we derive the following weighted averages

	Native platinum	Iridosmium
Platinum	89 88	48
Iridium	4 88	60 37
Osmium	1 92	33 53
Rhodium	2 47	3 59
Palladium	83	Trace
Ruthenium	.011	2 05

Recent figures[2] give the composition of Russian crude platinum as platinum, 83 per cent, iridium, 2 per cent, palladium, 0 5 per cent, rhodium, 0 6 per cent, iron, etc, 13 9 per cent It is doubtful if these figures can be relied on as general

An approximation of the amount of iridosmium compared with platinum can be made from the amount produced over a long period of years. The present proportion (1925) of 9 per cent as much iridosmium as platinum is obviously too large, owing to the stimulation of production by the abnormally high price of iridium, while the earlier production of 1 per cent to 3 per cent. is as obviously low, from the slight market demand for iridosmium and the metals obtained from it. We may fairly assume 5 per cent. as about the proper proportion of iridosmium to platinum. On this basis, our figures for

[1] Trottarelli *Gazz chim ital* 20 (1890), 611, Davidson. *Amer J Sci* (4), 7 (1899), 4.

[2] *Afr. Mining Eng. J.* 38 (1927), 123.

the relative amounts of the platinum metals in nature, considering platinum as 100,000, become.

Platinum	100,000
Iridium	8,793
Osmium	4,046
Rhodium	3,947
Palladium	924
Ruthenium	236

Using the estimate of these metals in the Canyon Diablo meteorite, and combining it with Clarke's estimate of the relative amounts of iron, nickel and cobalt, we arrive at the following figures for the amount of the metals of the eighth group in the earth, considering iron as 1,000,000,000

Calculating from *platinum* in the Canyon Diablo meteorite

Iron	1,000,000,000
Nickel	59,524,000
Cobalt	4,122,000
Platinum	12,043
Iridium	1,055 1
Osmium	488 5
Rhodium	343 6
Palladium	106 8
Ruthenium	28 3

If the calculations are based on the *iridium* reported in the Canyon Diablo meteorite, the figures become

Iron	1,000,000,000
Nickel	59,524,000
Cobalt	4,122,000
Platinum	70,926
Iridium	6,236 6
Osmium	2,868 0
Rhodium	2,094 7
Palladium	656 8
Ruthenium	167 9

but owing to the difficulty of determining iridium accurately, it is doubtful if these figures can be considered reliable.

If calculation were made from South African iridosmium, the osmium figures would be larger, as this iridosmium apparently runs much above the average in osmium; on the other hand, osmium analyses are apt to be low, owing to volatilization. The palladium is lower than would be anticipated; in the Sudbury ores the palladium runs much higher in proportion to the platinum. The ruthenium is unexpectedly low, but is probably approximately correct.

JAS LEWIS HOWE
WASHINGTON AND LEE UNIVERSITY,
LEXINGTON, VIRGINIA

THE ENCYSTMENT OF PARAMOECIUM IN THE RECTA OF FROGS

So far as I know *Paramoecium* has not been definitely shown to encyst in nature nor in laboratory cultures In fact, most of the investigators who have worked with this organism state that they have never seen it encyst and are of the opinion that it does not possess the ability to do so. Hence the following observations, though incomplete, seem worthy of record.

Two to three c c of rich, milky-white cultures of *Paramoecium* (species not determined) were injected (by attaching a short catheter to a syringe) into the recta of frogs, with the result that encystment occurred in about two per cent of the frogs injected In all, encystment has been observed in three frogs When it was first observed, two hours had elapsed since the paramoecia were introduced into the rectum. When a portion of the rectal contents was examined a fair number of individuals were observed in what later seemed to be the beginning of encystment, although at first they were very nearly overlooked for *Opalina* More careful observations, however, disclosed a very thin membrane-like substance surrounding them By continued observations it was finally possible to observe six individuals regain their normal *Paramoecium* shape, appearance and activity by freeing themselves of the peculiar substance enclosing them It was really not possible until the organisms had freed themselves of the membranes to determine whether I was observing *Paramoecium*, some undescribed parasitic ciliate of frogs, or *Opalina* in an abnormal condition, because they presented a very unusual appearance due to the fact that they were folded and rounded so as to occupy about half their normal space Others, however, were not able to free themselves and, after an hour or two, became more and more rounded and definitely enclosed within what, by this time, could be called a definite membrane—perhaps a cyst membrane

In another frog which was examined five and a half hours after injection per rectum only encysted paramoecia were present. These were placed in three depression slides, four organisms on one slide and several on each of the others, and kept in a moist chamber and observed several times daily No change was noticed for the first three days, but on the fourth day some of the cysts were undergoing fission, and on the fifth day two organisms were seen within a single cyst. A fairly heavy cyst wall was clearly visible. On the fifth day some paramoecia excysted.

When a considerable amount of tap-water was added, it was noticed that very soon the movement, which had been quite slow, was gradually increased and in three instances was observed to bring about excystation after two hours As the movement of the organism became more rapid the cyst wall became thinner and thinner until the organism was finally able to free itself and swim away Shortly before the organism was free, it could be seen pushing against the cyst wall which by this time had become a very thin membrane which would bulge out as the organism pushed against it from within Several of the cysts produced in this experiment were observed for eight days when they were accidently lost due to evaporation of the water containing them None of the encysted paramoecia were ever observed to lose movement entirely, although movement in some was very feeble indeed

In another instance paramoecia were injected into the recta of five frogs After four and a half hours the frogs were examined, four contained a few free and fairly active paramoecia and no cysts, and one contained cysts with thick heavy walls and no free paramoecia

In many instances the paramoecia were all dead within three to four hours after injection into the frog's rectum A very high percentage were killed and disintegrated (digested perhaps) within one to two hours, or before encystment was ever observed to occur

All attempts to bring about encystment in removed recta, in removed rectal contents, in the recta of killed frogs, and in the stomach and intestines failed

We may have in these meager observations an inkling as to the origin of parasitism, during the protection afforded by encystment a free-living organism may gradually become acclimatized or adapted to its new and unfavorable environment and finally become a parasite It would perhaps be a worth while undertaking to place in the alimentary tract and in the tissues of animals the cysts and free forms of some of the well known free-living ciliates which form cysts readily in nature and in culture After thousands of failures it might be possible to find an organism that could excyst and then maintain itself on the intestinal bacterial flora

L R Cleveland

NATURAL AND EXPERIMENTAL INGESTION OF PARAMOECIUM BY COCKROACHES

About thirty cockroaches were collected in the basement of a department store in Baltimore between eight and nine in the morning They were placed in a dry bottle and carried to the laboratory where several were dissected about two hours later and their stomach and rectal contents examined microscopically. Three of those examined had *Paramoecium* in their stomachs No attempt was made to determine the species of *Paramoecium*, but the observation was verified by three individuals in the laboratory who were familiar with this well-known organism The usual parasitic protozoa were seen in the rectal contents, but *Paramoecium* was only observed in the stomach The remaining cockroaches (17 in all) were left to be examined later to see if *Paramoecium* remained present and if it reached the rectum These were all opened up and observed between three and four in the afternoon, seven to eight hours after they were collected, and no living paramoecia were present in any of them, but the remains of paramoecia were clearly visible in the stomach contents of two individuals

In order to determine how long *Paramoecium* would live in cockroaches, approximately two hundred individuals were collected and were starved in dry petri dishes from one to ten days before being fed a rich, milky-white culture of *Paramoecium*, containing hundreds of individuals per drop In most of the experiments the cockroaches were starved four or five days because it was somewhat difficult to get them to ingest paramoecia after one to two days' starvation Each cockroach was placed in a petri dish and was observed until it ingested from one to three drops of the culture, the time was noted, and then the cockroach was removed from the petri dish with forceps, swabbed off with cotton, and placed in another petri dish with blotting paper in the bottom A hundred and fifteen observations were carried out in this manner The cockroaches were dissected at intervals from five minutes to three days after having been observed to feed on *Paramoecium* The contents of their alimentary tracts were examined microscopically, with the result that few, if any, of the paramoecia were killed during the first two hours after ingestion and that all were killed by the end of five hours except in a single instance where three actively motile paramoecia were found in the stomach contents six hours after ingestion When the stomach contents were examined three and four hours after the ingestion of paramoecia, mostly broken up or disintegrating organisms were observed together with three or four normally active individuals This, then, makes it highly probable that the cockroaches in which *Paramoecium* naturally occurred had fed on water containing a fair number of these organisms shortly before they were collected and brought to the laboratory—perhaps a rather unusual occurrence.

L. R Cleveland

Department of Tropical Medicine,
Harvard University Medical School,
Boston, Mass.

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CONTENTS

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THE OUTSTANDING PROBLEMS OF RELATIVITY[1]

IT was in January, 1914, that Einstein[2] made his great departure from the Newtonian doctrine of gravitation by abandoning the idea that the gravitational potential is scalar The thirteen eventful years which have passed since then have seen the rapid development of the new theory, which is called general relativity, and the confirmation by astronomers and astrophysicists of its predictions regarding the bending of light rays by the sun and the displacement of spectral lines At the same time a number of new problems have arisen in connection with it, and perhaps the time has now come to review the whole situation and to indicate where there is need for further investigation

Speaking from this chair I may perhaps be permitted to recall that my first experience of the British Association was as one of the secretaries of Section A nearly thirty years ago, and that my secretarial duties brought me the privilege of an introduction to the distinguished mathematical physicist, Professor G F FitzGerald, of Dublin, who was a regular and prominent member of the section until his death in 1901. FitzGerald had long held an opinion which he expressed in 1894 in the words "Gravity is probably due to a change of structure of the ether, produced by the presence of matter"[3] Perhaps this is the best description of Einstein's theory that can be given in a single sentence in the language of the older physics: at any rate it indicates the three salient principles, firstly, that gravity is not a force acting at a distance, but an effect due to the modification of space (or, as FitzGerald would say, of the ether) in the immediate neighborhood of the body acted on, secondly, that this modification is propagated from point to point of space, being ultimately connected in a definite way with the presence of material bodies, and thirdly, that the modification is not necessarily of a scalar character The mention of the ether would be criticized by many people to-day as something out of date and explicable only by the circumstance that FitzGerald was writing thirty-three years ago, but even this criticism will not be universal, for Wiechert and his fol-

[1] Address before Section A—Mathematical and Physical Sciences—the British Association for the Advancement of Science, Leeds, 1927

[2] *Zeits. f. Math. u. Phys.* 63 (1914), p 215.

[3] FitzGerald's *Scientific Writings*, p. 313.

lowers have actually combined the old ether theory with ideas resembling Einstein's by the hypothesis that gravitational potential is an expression of what we may call the specific inductive capacity and permeability of the ether, these qualities being affected by the presence of gravitating bodies. Assuming that matter is electrical in its nature, it is inferred that matter will be attracted to places of greater dielectric constant It seems possible that something of this sort was what FitzGerald had in mind

Let us now consider some of the consequences of Einstein's theory One of the first of them is that when a planet moves round a central attracting body in a nearly circular orbit, the perihelion of the orbit advances by (approximately) $6\pi v^2/c^2$ in each revolution, where v is the planet's velocity and c is the velocity of light This gives for the motion of the perihelion of Mercury almost exactly the amount (42″ per century) which is found from observation Another consequence is that light-rays which pass near a massive body are deflected, the bending at the sun's limb being 1″ 75 This was confirmed observationally by the British expeditions to the eclipse of May, 1919, and still more decisively by the Lick Observatory expedition to the Australian eclipse of September, 1922 the Lick observers found for the shift 1″ 72 ± 0″ 11, which differs from Einstein's predicted value by much less than its estimated probable error. Yet another result of general relativity is that, by the principle of equivalence, light which reaches us from a place of different gravitational potential (such as the sun) must exhibit a kind of Doppler effect This "gravitational shift of the solar spectral lines" is now generally admitted to be confirmed by comparisons of wave-lengths at the center of the sun's disc with wave-lengths from the arc *in vacuo*, and in 1925 the effect was observed, on a much larger scale, by W. S Adams in the spectrum of the companion of Sirius

Besides the effects which have been verified observationally there are many consequences of Einstein's theory which are of interest as opening up new fields or presenting new interrelations of phenomena in astronomy and physics For instance, there is a contribution to the precession of the equinoxes which, unlike ordinary precession, does not depend on the oblateness of the earth Again, the bending of the rays of light near a gravitating body, which has been observed in the case of the sun and the companion of Sirius, may, theoretically at any rate, be so pronounced that the ray is permanently captured by the attracting body, and describes forever a track round and round it, which approaches spirally and asymptotically to a circle whose center is at the center of gravitation Yet another deduction is that an electrified body, or a single electron, which is at rest in a varying gravitational field, must emit radiation. Indeed, now that a definite connection has been set up between electricity and gravitation, the whole of electromagnetic theory must be rewritten.

As a further illustration of the (as yet) unexplored possibilities of the new physics, let us consider the well-known equations for the potential of Newtonian gravitation, namely Laplace's equation

$$\frac{\delta^2 V}{\delta x^2}+\frac{\delta^2 V}{\delta y^2}+\frac{\delta^2 V}{\delta z^2}=0$$

in space where there is no matter, and Poisson's ¶ equation

$$\frac{\delta^2 V}{\delta x^2}+\frac{\delta^2 V}{\delta y^2}+\frac{\delta^2 V}{\delta z^2}=-4\pi\varrho$$

in space where matter of density ϱ is present In general relativity, when the field is statical, these are replaced by an equation

$$\Delta_2 V = 4\pi V\left(\sum_{i,k=1}^{3} a^{ik}T_{ik}+\frac{T_{00}}{N^2}\right)$$

where $\Delta_2 V$ is the Beltrami's second differential parameter for the form $ds^2=\Sigma a_{ik}\,dx_i\,dx_k$ which specifies the line-element in the three-dimensional space, T_{ik} is the energy-tensor, and N is the velocity of light at the point This equation reduces to Laplace's equation in one extreme case (when no matter or energy is present at the point) and to Poisson's equation in another extreme case (when the energy is entirely in the form of ordinary matter), but it offers an infinite variety of possibilities intermediate between the two, in which energy is present but not in the form of ordinary matter. It is possible that this equation, which evidently suggests an approach to the new wave-mechanics, may play as important a part in the microphysics and astrophysics of the future as the equations of Laplace and Poisson have played in the ordinary physics of the past

Let us take another consequence of the new theory. Consider the field due to a single gravitating particle. Take any plane through the particle, and in this plane draw the family of concentric circles, whose center is at the particle The length of the circumference of these circles will, of course, diminish as we take circles nearer to the center and at one place we shall have a circle whose circumference is of length

$$4\pi\beta M/c^2$$

where β is the Newtonian constant of attraction, M is the mass of the particle in grams, and c is the velocity of light in empty space. When we arrive at this circle we find that the element of length directed radially towards the center is infinite: that is to say, the space within the circle is impenetrable. Every gravitating

particle has a ring-fence around it, within which no other body can approach.

It will be noticed that in all that I have said I have used the ordinary language of three-dimensional physical space, and have avoided mention of that four-dimensional world of space-time which looms so largely in most expositions of relativity. The reason is that I have been speaking only of phenomena belonging to the statical class, *i. e.*, those for which the field does not vary with the time; and for such phenomena, as Levi-Civita showed in a famous paper on the *Rendiconti dei Lincei* of 1917, the four-dimensional problem can be reduced to a three-dimensional one of the same kind as physicists have been accustomed to deal with. It may be consoling to those who distrust their own powers of doing research in four dimensions to know that in general relativity there are enough important unsolved problems of the statical type, for which capacity in three dimensions is sufficient to keep all the investigators of the world busy for at least another generation.

It is interesting to see how these new three-dimensional problems differ from those of the older physics. Taking as an example a small particle moving in a statical field in general relativity, we find that the motion is determined by Lagrangian differential equations

$$\frac{d}{dt}\left(\frac{\delta L}{\delta \dot{x}_r}\right)-\frac{\delta L}{\delta x_r}=0 \qquad (r=1,\ 2,\ 3)$$

just as in the classical dynamics; but L is not now a simple difference of terms of the "kinetic energy" and "potential energy" types. It shows the sound instinct of the creators of the old dynamics that they almost always studied the equations without making the assumption that L consists of terms of kinetic and potential type; and thus their discoveries remain perfectly valid in the dynamics of general relativity.

The fundamental researches of Einstein and Hilbert, with the discovery of the field equations of gravitation, were published in 1915. At that time German scientific journals did not reach this country regularly, and British physicists and mathematicians were mostly occupied in one way or another with duties arising out of the great war; so that comparatively little notice was taken of the new theory on this side of the North Sea during the first year or two of its existence, and indeed it was not until the end of the war that most of us had any opportunity of studying it. In Germany, however, it was quickly realized that general relativity was one of the most profound and far-reaching contributions that had ever been made to science. Its successful prediction of new phenomena of a most unexpected kind was an event of the first importance, but still more significant was its complete subversion of the foundations of physics and reconstruction of the whole subject on a new basis. From time immemorial the physicist and the pure mathematician had worked on a certain agreement as to the shares which they were respectively to take in the study of nature. The mathematician was to come first and analyze the properties of space and time, building up the primary science of geometry; then, when the stage had thus been prepared, the physicist was to come along with the dramatis personæ—material bodies, magnets, electric charges, light and so forth—and the play was to begin. But in Einstein's revolutionary conception, the characters created the stage as they walked about on it; geometry was no longer antecedent to physics, but indissolubly fused with it into a single discipline. The properties of space, in general relativity, depend on the material bodies that are present; Euclidean geometry is deposed from its old position of priority and from acceptance as a valid representation of space; indeed its whole spirit is declared to be alien to that of modern physics, for it attempts to set up relations between points which are at a finite distance apart, and thus is essentially an action-at-a-distance theory; and in the new world no direct relations exist at all except between elements that are contiguous to each other.

The scheme of general relativity, as put forward by Einstein in 1915, met with some criticism as regards the unsatisfactory position occupied in it by electrical phenomena. While gravitation was completely fused with metric, so that the notion of a mechanical force on ponderable bodies due to gravitation attraction was completely abolished, the notion of a mechanical force acting on electrified or magnetized bodies placed in an electric or magnetic field still persisted as in the old physics. This seemed to be an imperfection, and it was felt that sooner or later everything, including electromagnetism, would be reinterpreted and represented in some way as consequences of the pure geometry of space and time. In 1918 Weyl proposed to effect this by rebuilding geometry once more on a new foundation, which we must now examine.

Weyl fixed attention in the first place on the "light-cone," or aggregate of directions issuing from a world-point P, in which light-signals can go out from it. The light-cone separates those world-points which can be affected by happenings at P, from those points whose happenings can affect P; it, so to speak, separates past from future, and therefore lies at the basis of physics. Now the light-cone is represented by the equation $ds^2=0$, where ds is the element of proper time, and Weyl argued that this equation, rather than the quantity ds^2 itself, must be taken as the starting-point of the subject; in other words, it is the *ratios* of the ten coefficients g_{pq} in ds^2, and not the *actual*

values of these coefficients, which are to be taken as determined by our most fundamental physical experiences. Following up this principle, he devised a geometry more general than the Riemannian geometry which had been adopted by Einstein instead of being specified, like the Riemannian geometry, by a single quadratic differential form

$$\sum_{p,q} g_{pq} dx_p dx_q$$

it is specified by a quadratic differential form

$$\sum_{p,q} g_{pq} dx_p dx_q$$

and a linear differential form $\sum_p \varphi_p dx_p$ together The coefficients g_{pq} of the quadratic form can be interpreted, as in Einstein's theory, as the potentials of gravitation, while the four coefficients φ_p of the linear form can be interpreted as the scalar-potential and the three components of the vector-potential in Maxwell's electromagnetic theory Thus Weyl succeeded in exhibiting both gravitation and electricity as effects of the metric of the world

The enlargement of geometrical ideas thus achieved was soon followed by still wider extensions of the same character, due to Eddington, Schouten, Wirtinger and others From the point of view of the geometer, they constituted striking and valuable advances in his subject, and they seemed to offer an attractive prospect to the physicist of combining the whole of our knowledge of the material universe into a single unified theory The working out of the various possible alternative schemes for identifying these more general geometries with physics has been the chief occupation of relativists during the last nine years Many ingenious proposals and adaptations have been published, and more than one author has triumphantly announced that at last the problem has been solved But I do not think that any of the theories can be regarded as satisfactory, and within the last year or two a note of doubt has been perceptible, were we after all on the right track? At last Einstein himself[4] has made up his mind and renounced the whole movement The present position, then, is that the years 1918–1926 have been spent chiefly in researches which, while they have contributed greatly to the progress of geometry, have been on altogether wrong lines so far as physics is concerned, and we have now to go back to the pre-1918 position and make a fresh start, with the definite conviction that the geometry of space-time is Riemannian

Granting then this fundamental understanding, we have now to inquire into the axiomatics of the theory This part of the subject has received less attention in our country than elsewhere, perhaps because of the more or less accidental circumstance that the most prominent and distinguished exponents of relativity in England happened to be men whose work lay in the field of physics and astronomy rather than in mathematics, and who were not specially interested in questions of logic and rigor It is, however, evidently of the highest importance that we should know exactly what assumptions must be made in order to deduce our equations, especially since the subject is still in a rather fluid condition, and there is a possibility of effecting some substantial improvement in it by a partial reconstruction of the foundations

What we want to do, then, is to set forth the axiomatics of general relativity in the same form as we have been accustomed to give to the axiomatics of any other kind of geometry—that is, to enunciate the primitive or undefined concepts, then the definitions, the axioms, and the existence-theorems, and lastly the deductions. In the course of the work we must prove that the axioms are compatible with each other, and that no one of them is superfluous

The usual way of introducing relativity is to talk about measuring-rods and clocks. This is, I think, a very natural and proper way of introducing the doctrine known as "special relativity," which grew out of FitzGerald's hypothesis of the contraction of moving bodies, and was first clearly stated by Poincaré in 1904, and further developed by Einstein in 1905 But general relativity, which came ten years later, is a very different theory In general relativity there are no such things as rigid bodies—that is, bodies for which the mutual distance of every pair of particles remains unaltered when the body moves in the gravitational field. That being so, it seems desirable to avoid everything akin to a rigid body—such, for example, as measuring-rods or clocks—when we are laying down the axioms of the subject The axioms should obviously deal only with the simplest constituents of the universe Now if one of my clocks or watches goes wrong, I don't venture to try and mend it myself, but take it to a professional clockmaker, and even he is not always wholly successful, which seems to me to indicate that a clock is not one of the simplest constituents of the universe. Some of the expounders of relativity have recognized the existence of this difficulty, and have tried to turn it by giving up the ordinary material clock with its elaborate mechanism, and putting forward in its place what they call an atomic clock; by which they mean a single atom in a gas, emitting light of definite frequency. Unfortunately the atom is apparently quite as complicated in its working as a material clock, perhaps more so, and is less understood, and the statement that the frequency is the same under all conditions

[4] *Math Ann.* 97 (1926), p 99

whatever is happening to the atom, is (whether true or not) a highly complex assumption which could scarcely be used in an axiomatic treatment of the subject until it has been dissected into a considerable number of elementary axioms, some of them perhaps of a disputable character

It seems to me that we should abandon measuring-rods and accurate clocks altogether, and begin with something more primitive Let us then take any system of reference for events—a network of points to each of which three numbers are assigned—which can serve as spatial coordinates, and a number indicating the succession of events at each point to serve as a temporal coordinate Let us now refer to this coordinate system, the paths which are traced by infinitesimal particles moving freely in the gravitational field Then it is one of the fundamental assumptions of the theory that these paths are the geodesics belonging to a certain quadratic differential form

$$\sum_{p\,q} g_{pq}\,dx_p dx_q$$

The truth or falsity of this assumption may, in theory at any rate, be tested by observation, since if the paths are geodesics they must satisfy certain purely geometrical conditions, and whether they do or not is a question to be settled by experience

Granting for the present that the paths do satisfy these conditions, let us inquire if a knowledge of the paths or geodesics is sufficient to enable us to determine the quadratic form The answer to this is in the negative, as may easily be seen if we consider for a moment the non-Euclidean geometry defined by a Cayley-Klein metric in three-dimensional space In the Cayley-Klein geometry the geodesics are the straight lines of the space, but a knowledge of this fact is not sufficient to determine the metric, since the absolute may be any arbitrary quadric surface

In order to determine the quadratic form in general relativity we must then be furnished with some information besides the knowledge of the paths of material particles It is sufficient, as Levi-Civita has remarked, that we should be given the null geodesics, *i e*, the geodesics along which the quadratic form vanishes In the Cayley-Klein geometry these are the tangents to the absolute, in general relativity they are simply the tracks of rays of light.

So from our knowledge of the paths of material particles and the tracks of rays of light we can construct the quadratic form

$$\sum_{p,q} g_{pq}\,dx_p dx_q$$

and then we are ready for the next great axiom, namely, Einstein's principle of covariance, that "the laws of nature must be represented by equations which are covariantive for the quadratic form

$$\sum_{p,q} g_{pq}\,dx_p dx_q$$

with respect to all point-transformations of coordinates."

The theory is now fairly launched and I need not describe its axiomatic development further The point I wish specially to make is that in the above treatment there has been no mention either of length or of time neither measuring-rod nor clock has been introduced in any way We have left open the question whether the quadratic form does or does not represent anything which can be given directly by measuring-rods and clocks For my own part I incline to think that the notions of length of material bodies, and time of clocks, are really rather complex notions which do not normally occur in the early chapters of axiomatic physics The results of the ether-drift experiments of D C Miller at Mount Wilson in 1925, if confirmed, would seem to indicate that the geometry which is based on rigid measuring-rods is actually different from the geometry which is based on geodesics and light-rays

The actual laws of nature are most naturally derived, it seems to me, from the Minimum Principle enunciated in 1915 by Hilbert, that "all physical happenings (gravitational, electrical, etc) in the Universe are determined by a scalar world-function $\mathfrak{H}$ being, in fact, such as to annul the variation of the integral

$$\int\int\int\int \mathfrak{H}\, dx_0 dx_1 dx_2 dx_3 \text{"}$$

This principle is the grand culmination of the movement begun 2,000 years ago by Hero of Alexandria with his discovery that reflected light meets the mirror at a point such that the total path between the source of light and the eye is the shortest possible In the seventeenth century Hero's theorem was generalized by Fermat into his "Principle of Least Time" that "Nature always acts by the shortest course," which suffices for the solution of all problems in geometrical optics A hundred years later this was further extended by Maupertuis, Euler and Lagrange into a general principle of "Least Action" of dynamical systems, and in 1834 Hamilton formulated his famous principle which was found to be capable of reducing all the known laws of nature—gravitational, dynamical and electrical—to a representation as minimum-problems.

Hilbert's minimum principle in general relativity is a direct application of Hamilton's principle, in which the contribution made by gravitation is the integral of the Riemann scalar curvature Thus gravitation acts so as to make the total amount of the curvature of space-time a minimum or as we may say, *gravitation simply represents a continual effort of the universe to straighten itself out* This is general relativity in a single sentence

I have already explained that the curvature of space-time at any point at any instant depends on the physical events that are taking place there in statical systems, where we can consider space of three dimensions separately from time, the mean curvature (*i.e.*, the sum of the three principal curvatures) of the space at any point is proportional to the energy-density at the point Since, then, the curvature of space is wholly governed by physical phenomena, the suggestion presents itself that the metric of space-time may be determined *wholly* by the masses and energy present in the universe, so that space-time can not exist at all except in so far as it is due to the existence of matter This doctrine, which is substantially due to Mach, was adopted in 1917 by Einstein, and has led to some interesting developments. The point at issue may be illustrated by the following concrete problem if all matter were annihilated except one particle which is to be used as a test-body, would this particle have inertia or not? The view of Mach and Einstein is that it would not; and in support of this view it may be urged that, according to the deductions of general relativity, the inertia of a body is increased when it is in the neighborhood of other large masses; it seems needless, therefore, to postulate other sources of inertia, and simplest to suppose that *all* inertia is due to the presence of other masses. When we confront this hypothesis with the facts of observation, however, it seems clear that the masses of whose existence we know—the solar systems, stars, and nebulæ—are insufficient to confer on terrestrial bodies the inertia which they actually possess, and therefore if Mach's principle were adopted, it would be necessary to postulate the existence of enormous quantities of matter in the universe which have not been detected by astronomical observation, and which are called into being simply in order to account for inertia in other bodies This is, after all, no better than regarding some part of inertia as intrinsic

Under the influence of Mach's doctrine, Einstein made an important modification of the field-equations of gravitation He now objected to his original equations of 1915 on the ground that they possessed a solution even when the universe was supposed void of matter, and he added a term—the "cosmological term" as it is called—with the idea of making such a solution impossible After a time it was found that the new term did not do what it had been intended to do, for the modified field-equations still possessed a solution—the celebrated "De Sitter World"—even when no matter was present, but the De Sitter world was found to be so excellent an addition to the theory that it was adopted permanently, and with it of course the cosmological term in the field-equations, so that this term has been retained for exactly the opposite reason to that for which it was originally introduced.

The "De Sitter World" is simply the universe as it would be if all minor irregularities were smoothed out just as when we say that the earth is a spheroid, we mean that the earth would be a spheroid if all mountains were leveled and valleys filled up: In the case of the De Sitter universe the leveling is a more formidable operation, since we have to smooth out the earth, the sun, and all the heavenly bodies, and reduce the world to a complete uniformity. But after all, only a very small fraction of the cosmos is occupied by material bodies; and it is interesting to inquire what space-time as a whole is like when we simply ignore them

The answer is, as we should expect, that it is a manifold of constant curvature This means that it is isotropic (*i.e.*, the Riemann curvature is the same for all orientations at the same point), and is also homogeneous. As a matter of fact, there is a well-known theorem that any manifold which is isotropic in this sense is necessarily also homogeneous, so that the two properties are connected A manifold of constant curvature is a projective manifold, *i.e.*, ordinary projective geometry is valid in it when we regard geodesics as straight lines, and it is possible to move about in it any system of points, discrete or continuous, rigidly, *i.e.*, so that the mutual distances are unaltered

The simplest example of a manifold of constant curvature is the surface of a sphere in ordinary three-dimensional Euclidean space, and the easiest way of constructing a model of the De Sitter world is to take a pseudo-Euclidean manifold of five dimensions in which the line-element is specified by the equation

$$-ds^2 = dx^2 + dy^2 + dz^2 - du^2 + dv^2$$

and in this manifold to consider the four-dimensional pseudosphere whose equation is

$$x^2 + y^2 + z^2 - u^2 + v^2 = R^2.$$

The pseudospherical world thus defined has a constant Riemannian measure of curvature $-1/R^2$.

The De Sitter world may be regarded from a slightly different standpoint as having a Cayley-Klein metric, governed by an absolute whose equation in four-dimensional homogeneous coordinates is

$$x^2 + y^2 + z^2 - u^2 + v^2 = 0$$

where u is time Hyperplanes which do not intersect the absolute are spatial, so spatial measurements are elliptic, *i.e.*, the three-dimensional world of space has the same kind of geometry as the surface of a sphere, differing from it only in being three-dimensional instead of two-dimensional In such a geometry there is a natural unit of length, namely, the length of the complete straight line, just as on the surface of a sphere there is a natural unit of length, namely, the length of a complete great circle.

We are thus brought to the question of the dimensions of the universe. what is the length of the complete straight line, the circuit of all space? The answer must be furnished by astrophysical observations, interpreted by a proposition which belongs to the theory of De Sitter's world, namely, that the lines of the spectrum of a very distant star should be systematically displaced, the amount of displacement is proportional to the ratio of the distance of the star from the observer to the constant radius of curvature R of the universe In attempting to obtain the value of R from this formula we meet with many difficulties the effect is entangled with the ordinary Doppler effect due to the radial velocity of the star, it could in any case only be of appreciable magnitude with the most distant objects; and there is the most serious difference of opinion among astronomers as to what the distance of these objects really is Within the last twelve months the distance of the spiral nebula M 33 Trianguli has been estimated by Dr Hubble, of the Mount Wilson Observatory, at 857,000 light-years, and by Dr Perrine, the director of the Cordoba Observatory, at only 30,000 light-years, and there is a similar uncertainty of many thousands per cent in regard to all other very remote objects Under these circumstances we hesitate to assign a definite length for the radius of curvature of the universe; but it is millions of light-years, though probably not greater than about a hundred millions. The curvature of space at any particular place due to the general curvature of the universe is therefore quite small compared to the curvature which may be imposed on it locally by the presence of energy By a strong magnetic field we can produce a curvature with a radius of only 100 light-years, and of course in the presence of matter the curvature is far stronger still So the universe is like the earth, on which the local curvature of hills and valleys is far greater than the general curvature of the terrestrial globe

In concluding these remarks I ought perhaps to apologize for having said nothing about the relation of general relativity to the new wave-mechanics. My excuse must be that, at the request of the secretary of the British Association, this address was sent to the printer many weeks before the meeting; and the wave-mechanics is developing so rapidly that, as one eminent worker has declared, anything printed is *ipso facto* out of date.

E. T. WHITTAKER

CHARLES FULLER BAKER—A SKETCH

CHARLES FULLER BAKER, scientist, collector and pioneer, is dead—conquered on the very eve of the release which his indomitable will had long promised a harassed body. The doctors scarcely said whether it was malignant malaria or amoebic dysentery or tuberculosis to which he succumbed at last

Five or six years ago, when I knew him as well as most men ever came to know him, Baker was living in a bamboo "bahai" on the outskirts of the dank little village of Los Baños, forty miles south of Manila.

There, in his two rooms among the tops of palm trees, with the stench of his neighbors' pigs and carabaos floating up through the cracks in his floor, he made additions to his superb collections of insects and fungi, and "thanked the Lord daily" for the ships which brought him letters from scores of unseen, unknown friends who had come to know and revere his solitary work as a scientist.

Though he was then only a little over fifty years, fever and a hundred tropic diseases had wasted his body and parched his skin, so that he looked more than seventy—very white of hair and intense of eye

Baker lived apart from the faculty of the College of Agriculture of which he was dean Between him and most of us was an intangible though not unfriendly something which kept him from knowing the men intimately Perhaps he found some compensation in the pioneer conditions, which, under earlier Wisconsin skies, had stirred the blood of his father, living there among the natives, cared for only by a Japanese servant and his wife, cooling his water in a swinging earthen jar and writing his innumerable letters

At any rate, few persons knew when intense pain made agony of his nights, or whether despair ever killed the stoic courage in his eyes Once, when I learned he was suffering from one of his recurrent attacks, I climbed the ladder-stairs of his shack and entered the gloom of his large single room. He was lying on a narrow rattan couch, very wizened, very pale, and yet very fierce in the still, dark heat.

"Buenos Dios, senor," he greeted me gaily, without moving I urged him to let us care for him, but it was obvious that that day at least he could not be moved.

The next noon he sent a note

"You are placing before me a fine temptation to be sick. You probably don't know that you are also tempting me to go back on one of my most cherished principles, not to give up, or to resign myself to conditions until the Angel Gabriel blows his horn."

After a week he was up once more, riding behind the gray nag along the blazing three miles of road to the college, and greeting natives and Americans alike with his sweeping, faintly mocking friendliness

Baker virtually built the Philippine College of Agriculture He fought for the appropriations which kept it going; he sought eagerly for a faculty fired by a kindred zeal to his own, for using the tropics as a great laboratory in which to enrich human knowledge.

A work fraught *ab initio* with disappointment! A quest implicit with futility! Baker found few men so free of ambition for personal glory, so urged by passionate scientific curiosity, that they would suffer his exile unmindful of loneliness, disease, perilous trips, neither seeking nor expecting gratitude, wealth or even academic recognition

Next to the college he organized, to which come native lads from every part of the islands (Baker could capture their imaginations and stir their hopes as no other member of the faculty could, or bothered to do), Baker was interested chiefly in his entomological and mycological collections

He had a surpassing knowledge of insects and fungi and he showered the laboratories of collectors in the Orient and Europe with his specimens His own collections he gave in part to the College of Agriculture of the University of the Philippines, to the University of Hawaii and to the Smithsonian Institute in Washington, D C

Impressive monuments though they are to his intrepid, tireless spirit, the generations whose knowledge and whose living will be richer because of them, can scarcely glean from them a sense of the heroism of this rare and daring personality

Yet Baker was not coldly impersonal In strange contradiction to his own stoicism, he was generous and sympathetic with people whose difficulties were not a fraction so severe as his own

Once he gave up a long-cherished plan for a trip to another more remote part of the islands, because a native boy who was dying of tuberculosis had neither money nor friends to care for him Baker took the money he had put aside for the trip and sent the lad to the mountains For his own part, he stayed in his shack and classified his treasured insects

In his death, science has lost a worker whose invaluable contributions were all too obscured by his indifference to public recognition, and a host of scattered admirers must be reminded of his countless kindnesses

Colin G Welles

Milwaukee, Wisconsin

SCIENTIFIC EVENTS

INTERNATIONAL ELECTRICAL CONGRESSES

The Electrical Division of the Bureau of Standards has announced that it is represented at two international electrical conferences to be held in Italy this month The International Electrotechnical Commission meeting will be attended by the Assistant Chief of the Electrical Division, Dr J Franklin Meyer, and Dr J H Dellinger. Dr Meyer will also attend the meeting of the International Commission on Illumination.

The sessions of the Electrotechnical Commission, the Bureau announced orally, were held at Bellagio on Lake Como from September 5 to September 13, with a special trip to Como on September 11, when the centenary of the death of Volta was commemorated in conjunction with the International Congress of Physics. After the technical sessions at Bellagio, the delegates to the meeting made a 10-day tour to various power plants and industrial establishments in Italy, ending at Rome, where a final meeting was held for formal acceptance of the results of the Commission meetings

According to the preliminary program which has just been issued for the meeting, the Commission dealt with the standardization of electrical machinery and related problems, such as prime movers (steam engines and water turbines) During the meetings at Bellagio, consideration was given to specifications for such prime movers for switches, measuring instruments, insulating oils, lamp bases and holders, traction motors and radio electron tubes There was also a discussion of the methods of rating the power of electrical machinery, of rating rivers in connection with water-power development, and of an international technical vocabulary covering the field of work of the Commission

In addition to the government representatives mentioned, the sessions were attended by prominent engineers and executives, including representatives of the General Electric Company, the Westinghouse Electric & Manufacturing Company, the Edison Electric Illuminating of Boston, the New York Edison Company, the Electrical Testing Laboratories and a number of universities

The International Commission on Illumination, which met at Bellagio from August 31 to September 3, included national committees in Great Britain, France, Italy, Germany, Belgium, Switzerland and Japan, in addition to the United States. Its work included the unification of practice in making photometric tests, the establishment of standard technical vocabularies, and in general the furtherance of good practice in lighting in the several countries.

The Bellagio meeting considered several technical problems—a primary standard of light, standard methods of comparing lights of different colors and the investigation of glare Other matters dealing more directly with practice include proposed specifications for electric lamps, for street lighting and for the regulation of automobile headlights There was also some general discussion of the teaching of the science and art of illumination and of the activities of lamp manufacturers in Europe and in America looking toward the improvement of illumination.

In accordance with the action taken at the last

plenary session of the commission held in Geneva in 1924, it is planned that a full session of the commission will be held in the United States next year.

THE FIELD MUSEUM PALEONTOLOGICAL EXPEDITION IN SOUTH AMERICA

PROFESSOR ELMER S RIGGS, leader of the Second Field Museum—Captain Marshall Field Paleontological Expedition of 1926–1927 to Argentina—states in a report recently received that the expedition finished its first year's work about May 1 and returned to Buenos Aires The itinerary of the year included seven months collecting in the Province of Catamarca and a somewhat shorter period of similar work in the Province of Buenos Aires

The object of this expedition was to make collections of fossil mammals from the Pliocene and the Pleistocene formations of Argentina, and so to supplement the work of the First Expedition of 1923–24, which was directed toward the earlier Deseado and Santa Cruzean formations

The expedition, like the first, was conducted under the leadership of Professor Riggs, associate curator of paleontology of the museum, and its personnel included Robert C Thorne, of the museum staff, Dr Rudolph Stahlecker, of Tubingen, Germany, as collector and stratigrapher, and local help employed in the regions worked

The first base of operation was established at Andalgala, Catamarca From there the party proceeded by pack-train across the Sierra Aconquija to the Valley of Santa Maria, in the vicinity of the pueblo San Jose There camp was established and field operations begun in May, 1926 In this mild climate, at an altitude of 6,000 feet, it was possible to carry on the work of collecting throughout the winter months

On the eastern side of the Valley of Santa Maria and abutting the foot of the Sierra Aconquija was encountered the series of sedimentary rock-strata which has been designated as Catamarcense and referred to the Araucanian Period (Pliocene) The entire series of clays and sandstones here exposed has a thickness of about 6,000 feet It is highly inclined and complicated by local folding A part of this series has been known to be fossil-bearing since 1892, when fossil mammals were discovered there by an expedition of the La Plata Museum, under the direction of Professor Adolfo Methfessel Collections made by these gentlemen and by later Argentine collectors have been studied by Ameghino and others. They form an important part of the recorded Pliocene mammals of South America.

The better-known localities of Entre Rios, Rio Yapis and of Teopnuca were gone over by the Field Museum collectors with gratifying success Specimens of glyptodonts and of invertebrate fossils were discovered in the lowermost strata of the series Careful sections were made of the entire formation and records kept of the faunas of the several horizons Search for fossils was then extended over some sixty miles of these exposures in the Santa Maria Valley Few fossils were found outside the localities explored by the Argentine collectors

Convinced that Araucanian deposits recorded from widely separated districts of Catamarca belonged to the same period as that of the Santa Maria Valley, and acting upon apparently reliable information derived from local sources, the party pushed southward and westward into the Department of Belen In the vicinity of Puerto Corral Quemada was found the formation *Catamarcense* exposed in a magnificent series, having a thickness of 7,000 feet A fossil fauna similar to that known from the Santa Maria Valley was also recognized This fauna was further supplemented in the upper series by more modern types of glyptodonts, armadillos and macrauchenids, which indicated a nearer approach to Pleistocene time Among this strictly indigenous South American fauna there were recognized no immigrants of North American or European type

At Puerto Corral Quemada a new base of operations was established Three months of intensive collecting, with accompanying stratigraphic studies and records, brought together a wealth of fossil mammals The collection from the two localities, while including only a few mountable skeletons, is rich in skulls and in specimens of the dermal armaments of glyptodonts and armadillos Other groups represented by fine specimens are the typotheres, the protypotheres, the toxodonts, the macrauchenids, the gravigrade sloths, the marsupial carnivores, rodents of great variety, several large birds, a single great tortoise and a batrachian The number totals 188 specimens, representing more than thirty known genera

At the close of this collecting, the expedition was visited in the field by a delegation from the Argentine Museums of Buenos Aires, who leniently and courteously applied the Argentine law of embargo on the exportation of such collections

With the approach of the rainy season in Catamarca, the party proceeded to the southern coast of the Province of Buenos Aires in quest of the great Pleistocene mammals of the pampean formations. This field, long known to be rich in fossil mammals, was found to offer but limited exposures available as collecting grounds Moreover, the coast-line and the banks of a small number of rivers which have cut through the fertile wheat-belt of Argentina are sys-

tematically gone over year after year by collectors from the Argentine museums.

Such a field could not be expected to yield a rich collection The Field Museum Expedition was rewarded, however, by finding some good articulated skeletons of the great ground sloths, Scelidodon, Glossotherium and Megatherium, as well as less complete specimens of the great saber-tooth tiger, Smilodon, and the South American Mastodon All of these specimens of well-known animals were permitted to be exported to North America

The expedition at latest reports was continuing the search for Pleistocene mammals in other fields

THE BARTOL FOUNDATION

DR. W F. G SWANN returned on September 1 from a summer in England and France to take up his new work as director of the Bartol Foundation

Eight research fellows will work in the foundation's laboratories, at 127 North 18th Street, Philadelphia, where it will be housed for the coming year, pending completion of the building now to be built for its use on the Swarthmore campus, as was announced recently by Dr W. C L. Eglin, president, and Dr. Howard McClenahan, secretary, of the foundation.

Dr. Swann announced the plan of inviting distinguished physicists, men of achievement in research and of international standing, to visit the foundation for a month at a time—not for the mere giving of a lecture, but to spend weeks in the laboratories, in conference with the staff regarding their investigations and regarding the unsolved problems, in general, of physics and of physical chemistry

There are but few places in the world where research on the fundamental problems of physics, as distinguished from research regarding applications of scientific discovery, are going on under such conditions of undisturbed freedom for uninterrupted investigation as prevail at the Bartol Foundation

Most closely akin are the Royal Institution, in London, the physical institutes at some of the great German universities, the Institute of Physics at the University of Leiden, in the Netherlands and the laboratory of Dr Niels Bohr in Copenhagen

The research fellows now at work at the foundation are Dr Henry A Barton, trained at Harvard and recently a fellow of the National Research Council, Dr Arthur Bramley, from Princeton University, Dr E O Frivold, from the University of Oslo, Norway; Dr Thomas Hope Johnson, recently a Sterling fellow at Yale University, Dr Wayne B Nottingham, from Princeton University, Dr Cassimiro del Rosario, formerly a Sterling fellow at Yale University, Dr. L. R Maxwell, a guest at the foundation as holder of a research fellowship of the National Research Council, and Dr Mildred Allen, who worked in physics at Yale University under Dr Swann and now is a guest investigator. Andrew Longacre has also come from Yale University as a research assistant

THE NEW BUREAU OF CHEMISTRY AND SOILS

DR. HENRY G KNIGHT, dean of the college of agriculture and director of the experiment station of the University of West Virginia, has been appointed chief of the new Bureau of Chemistry and Soils of the United States Department of Agriculture by Secretary W M Jardine Dr Knight is a man of broad training in chemistry, soils and agronomy, and of extensive experience in directing research in these fields He will assume his new duties about October 1

The new Bureau of Chemistry and Soils which Dr Knight is to direct combines three important research fields in the department—chemistry, soils and fixed nitrogen—formerly represented by the old Bureau of Chemistry, the Bureau of Soils and the Fixed Nitrogen Research Laboratory. The new bureau was provided for by the last Congress at the request of Secretary Jardine, and took form at the beginning of the present fiscal year on July 1

While each of these three groups maintains its identity in the new organization, they will be associated in such a way as to facilitate the fullest cooperation and coordination of the research work. The fields covered are closely related and vitally important to agricultural development

The research work in chemistry and chemical technology embraces fifteen divisions, taking in the research units of the old Bureau of Chemistry This work in chemistry will be headed by Dr C A Browne, who has been chief of the former Bureau of Chemistry, assisted by Dr. W. W Skinner, who was assistant chief. Dr Browne will also act as associate chief of the new bureau, but will, at his own request, devote his major energies to research work in chemistry.

Dr. F G Cottrell, who has been head of the fixed-nitrogen and fertilizer research group of divisions, continues as head of this work in the new bureau

Dr. A G. McCall, formerly professor in geology and soils of the University of Maryland and also formerly connected with the old Bureau of Soils of the United States Department of Agriculture, was recently appointed head of the soils work of the new Bureau of Chemistry and Soils. He was executive secretary of the First International Congress of Soil Science, which was held in Washington, D. C., in June.

Dr. Knight therefore becomes the head of an organization which has in charge of its subdivisions men of the highest standing who are recognized leaders in their special scientific fields. With highly trained specialists throughout the new bureau it promises to be a very effective agency in promoting the welfare of agriculture

Dr. Knight was born at Bennington, Kans, July 21, 1878. He received the degree of bachelor of arts from the University of Washington in 1902, and the degree of master of arts from the same institution in 1904 He was a fellow at the University of Chicago in 1903, and received the degree of doctor of philosophy from the University of Illinois in 1907 He was assistant chemist in the University of Washington in 1903–04, professor of chemistry and state chemist of Washington 1904–1910, and director of the Washington Agricultural Experiment Station 1910–18 He served as dean of the college of agriculture and director of the experiment station of the University of Oklahoma 1918–20. He was honorary fellow at Cornell University in 1921–22 In 1922 he was appointed to the positions in West Virginia which he now resigns to accept the appointment in the Department of Agriculture

Dr Knight has taken active part in promoting research through the American Association of Agricultural Colleges and Experiment Stations (now the Association of Land Grant Colleges), he was a member of the executive committee of that association for several years. He is a fellow of the American Institute of Chemists, and a member of the American Chemical Society, the American Association for the Advancement of Science, Sigma Xi, Phi Beta Kappa, Alpha Zeta, Phi Kappa Phi and other societies

SCIENTIFIC NOTES AND NEWS

THE autumn meeting of the National Academy of Sciences will be held at the University of Illinois at Urbana on October 18, 19 and 20

CITIZENS' lectures at the Leeds meeting of the British Association were arranged as follows Sir Oliver Lodge, "Energy", Dr MacGregor Skene, "By-Products of Plant Activity" Children's lectures Mr. Kingdon Ward, "Plant Hunting on the Roof of the World", Dr Clarence Tierney, "Nature's Secrets"

FOUR of the delegates to the World Poultry Congress at Ottawa were honored in Quebec on August 9, when, following a luncheon in honor of the delegates, the Honorable J E. Caron, Minister of Agriculture, presented to them the Mérite Agricole decoration of the Province of Quebec The four delegates receiving the decoration were: P. A. Francis, of the British Agricultural Department; Professor Don Salvador Castello, director and founder of the Royal Spanish Poultry School; W A. Kock, of Copenhagen, head of the Danish delegation to the congress, and R. W Dunlap, assistant secretary of agriculture of the United States

AT the close of the summer session of the Iowa State College, where he was formerly a student, Clarence D Chamberlin, who recently made a successful flight from New York to Germany, received a certificate of distinguished service in aviation engineering

DR THEODOR WIEGAND, director of the State Museum in Berlin, has been elected a corresponding member by the Vienna Academy of Sciences.

DR. BÉCLÈRE has been elected vice-president of the Paris Academy of Medicine, in place of Dr Balzer, who has resigned

DR LAURENCE H SNYDER, associate professor of zoology at North Carolina State College, has been elected a foreign member of the Deutsche Gesellschaft fur Blutgruppenforschung

J D RUE, chief of the U S Forest Products Laboratory's pulp and paper section, will leave the laboratory about September 15 to become director of research for the Champion Fibre Company, of Canton, N C

AFTER spending some time in England and France, President Clarence Cook Little, of the University of Michigan, will go to the Faroe Islands to collect a species of mice to be used in his biological research He will take part in the World Population Congress at Geneva before returning to the United States

OWEN D YOUNG, chairman of the board of directors of the General Electric Company, returned from Europe on August 23 While abroad Mr Young served as chairman of the American delegation to the Stockholm meeting of the International Chamber of Commerce

DR WILLIAM CROCKER, director of the Boyce Thompson Institute, has left for Porto Rico The agricultural problems in that tropical island have become so important that the establishment of a graduate school of agriculture has been provided for, whose function will be to solve these problems The National Research Council at Washington, in charge of such projects, is to be represented by Dr Crocker, who is chairman of the division of biology and agriculture and the natural official to act as adviser He will study the situation, visiting the various agricultural regions, and will then help in organizing the graduate school so that it will be able to attack the problems effectively. He will probably be absent about three weeks on this mission.

DR W F DRAPER, assistant surgeon-general in charge of the domestic quarantine division of the Bureau of Public Health Service, will sail for Europe on September 6 to study public health methods in Germany for two months Dr Draper's trip is a part of the system of international interchange of public health officials inaugurated several years ago for the purpose of keeping health officials in each country acquainted with advances in their field made by the health officials of other nations

WITH the object of finding for the Field Museum of Natural History a suitable spot for representation in a habitat group illustrating the vegetation and landscape at the snow line of the Rocky Mountains, Dr B E Dahlgren, acting curator of botany at the museum, and an assistant, Emil Sella, have left Chicago for the west Dr Dahlgren and Mr Sella will be joined at Laramie, Wyoming, by Professor Aven Nelson, of the department of botany of the University of Wyoming The party will proceed first to the Medicine Bow Mountains in Wyoming, and will explore regions at an altitude of between 10,000 and 12,000 feet Thence they will go to Glacier National Park and elsewhere to continue their work The proposed group is to show the alpine vegetation above the timber line in the American Rockies Charles A Corwin, field museum artist, will paint a background for it, showing the transition from the well-timbered zone below to the barren snow line near the top of the mountains Actual specimens of the plant life of the region will be displayed

DR W J YOUDEN, a member of the staff of Boyce Thompson Institute, has been asked by the Forest Service of the Bureau of Plant Industry at Washington to help in planning an effective attack on the ravages of the white pine blister rust It is a problem that involves a study of the plants that carry the disease and also of the soils The disease has been baffling, because it occurs in scattered patches, with varying results In some patches it is very destructive, and in other patches there is every gradation The Government Forestry Service has spent much time in investigating it, and has accumulated a mass of data The plan is that Dr Youden shall study these data, determine the relative importance of the results, and work out a plan of attack He will devote about a month to this work, visiting the different white pine regions, and finally reaching California

DR MEIR WANNIK, professor of agricultural chemistry in the Mikveh-Israel University of Palestine and head of the agricultural experiment station connected with that school, who came to the United States as a delegate to the International Soil Congress, recently spent some time at the Davis branch of the College of Agriculture of the University of California, studying the work being done in soil moisture by Dr F J Viehmeyer, of the division of irrigation investigations

PROFESSOR R T LEIPER, F R S, director of the division of medical zoology in the London School of Hygiene and Tropical Medicine, known for his researches into bilharziasis in Egypt, has been invited by the Egyptian Government to continue them next winter, and to advise on the best methods of combating the disease.

DR. L KREHL has been appointed director of the Institute of Natural Therapy, which is conducted under the auspices of the government at the University of Jena The institute is affiliated with the Kaiser Wilhelm Institute and will include the Heidelberg Institute for Cancer Research and the Heidelberg Institute for Protein Research

DR. GEORGE ANDREWS HILL, senior astronomer of the Naval Observatory, died in Washington on August 29 He was sixty-nine years old

HENRY DALLAS THOMPSON, since 1894 professor of mathematics at Princeton University and for forty years a member of the faculty, has died in Santa Barbara, California Professor Thompson was sixty-three years old.

DR WILLIAM BURNSIDE, F.R S, late professor of mathematics at the Royal Naval College, Greenwich, died on August 21, aged seventy-five years

PROFESSOR OTTONE BARBACCI, of the chair of pathologic anatomy at the University of Siena, has died, at the age of sixty-seven years

THE triennial congress of the International Institute of Anthropology will be held at Amsterdam from September 19 to 24, under the presidency of Professor J P Kleiweg de Zwaan. It will comprise six sections (1) physical anthropology, (2) ethnography and ethnology, (3) heredity and eugenics, (4) sociology and criminology, (5) prehistory, (6) folklore The official languages will be French, German, English, Dutch, Spanish and Italian

THE *Journal* of the American Medical Association states that a group of 150 physicians belonging to the Interstate Postgraduate Assembly of North America arrived recently in Paris by way of Belgium. They were received by eminent members in the medical profession, who arranged for them to visit the principal scientific centers and hospitals. A reception was held at the Elysée by the president of the republic, who accepted an honorary diploma of membership.

THE second national symposium on organic chemistry will be held at Ohio State University, December 29, 30 and 31 Suggestions for the program should be sent to the secretary of the division of organic chemistry of the American Chemical Society, Professor Frank C Whitmore, Northwestern University, Evanston, Ill.

THE annual meeting of the American Association of Agricultural College Editors met during the last week in August at the Colorado State Agricultural College, Fort Collins

To commemorate the forty-fifth anniversary of the opening by Thomas A Edison of the first public electric light and power plant in the world in New York City, John W Lieb, vice-president and general manager of the New York Edison Company, who was associated with Mr Edison in that undertaking, on September 4 placed a wreath on a tablet which marks the site of the old plant The ceremony was witnessed by many of the men who were associated with Edison in pioneer days of the electric industry

CONSTRUCTION has been begun on a new building at New Orleans, La, for the tropical insect work of the Bureau of Entomology It will contain office and laboratory quarters, a cold room controlled by a refrigeration plant, greenhouse and insectary units, and a shop for the construction of special apparatus Storage space is provided for spray machinery and other field equipment, and two acres adjacent to the buildings are allotted for special experimental plots The laboratory will contain a battery of incubators and other special apparatus for study under controlled conditions, and full equipment will be provided for the statistical analysis of data gathered in field experimentation where conditions are not under control Thus factors developed by an analysis of the varying conditions in the field can be studied in parallel series under control in the laboratory

THE North Sea Aquarium of the State Biological Institute on the Island of Helgoland has recently been opened to the public. The aquarium, with some fifty large tanks, shows the complete fauna and flora of the North Sea The pipes that supply the tanks with sea water are of transparent celluloid, which is not subject to corrosion

THE Minnesota Legislature at its last session reestablished the $4,000 appropriation for the Minnesota Crop Improvement Association. This fund is used chiefly in the distribution, inspection and certification of improved seeds developed at the station The association is organized for the purpose of protecting these improved varieties and maintaining suitable stocks for seed purposes.

PROFESSOR LUIGI MANGIAGALLI has given his large private library to the Istituto Ostetrico-Ginecologico of the University of Milan, which bears his name The library contains, in addition to 10,000 bound volumes, a large number of unbound treatises and rare complete collections of scientific reviews

THE Establissements Dornalo, submarine specialists, will undertake in the course of the present season the taking of submarine views in the Mediterranean, in depths varying from 40 to 50 meters, with the help of a diving apparatus which will carry one man and a powerful motion picture projector Their purpose is to take views of submarine life in its natural surroundings, by attracting to the lighted area all species usually living in these depths These views will be used for making educational films The work will later be extended to the tropical regions

THE Women's Zionist Organization of America, known as Hadassah, voted recently to expend $609,000 in medical and health work in Palestine, most of which will be to support the Hadassah Medical Organization in that country In addition to that budget, the organization voted to raise $100,000 from revenues for medical service in Palestine The need for medical work in Palestine is considered urgent The convention expressed its gratitude in a unanimous resolution to Nathan and Mrs Straus, of New York, for their gift of $250,000 for a health center in Jerusalem

UNIVERSITY AND EDUCATIONAL NOTES

Two gifts amounting to $550,000 have been made to the medical school of the University of Chicago, $300,000 for the erection and equipment of a building to be known as the Gertrude Dunn Hicks Memorial, which shall be operated as an orthopedic hospital, and $250,000 from Mr Louis H Kuppenheimer to establish an endowment fund to be known as the Louis B and Emma M Kuppenheimer Foundation The income is to be used for teaching and research in the department of ophthalmology

PROFESSOR W B ZUKER, head of the department of chemistry of the University of Dubuque since 1921, has been appointed acting president of that institution beginning on September 1, when the resignation of Reverend K F Wettstone, D D, took effect

DR W L HOWARD, director of the Davis branch of the college of agriculture of the University of California, has been appointed associate dean of the College of Agriculture to assist in the administration of the college during the temporary and partial absence of Dean E. D. Merrill.

PROFESSOR I M KOLTHOFF, of the University of Utrecht, has accepted a professorship of analytical chemistry at the University of Minnesota and will begin his work in October Dr R. S Livingston, of the University of California, has been appointed assistant professor of physical chemistry

DR CARL SNEED WILLIAMSON, formerly of the Mayo Clinic, Rochester, Minn, has been appointed head of the department of surgery at the University of Arkansas School of Medicine, Little Rock, and Dr Oliver C Melson, also of the Mayo Clinic, has been appointed head of the department of medicine

AFTER many years' activity as lecturer on zoology at the institute for investigations in heredity in Berlin-Dahlem, Dr Paula Hertwig, the daughter of the former professor of biology, Oskar Hertwig, has been given the title of professor

DISCUSSION AND CORRESPONDENCE

AGE OF THE "SATSOP" AND THE DALLES FORMATIONS OF OREGON AND WASHINGTON

GEOLOGISTS have differed regarding the ages of the "Satsop" and the Dalles formations of the Columbia River Gorge region Because of their bearing on the history of the Gorge and for other reasons their ages are important.

During a brief investigation of these beds under the auspices of the Carnegie Institution of Washington, the writers secured fragmentary mammalian fossil remains from the Dalles formation representing not a Quaternary, but approximately an upper Miocene or lower Pliocene stage This age determination is corroborated by the lithologic resemblance of the Dalles beds to the middle Neocene Ellensburg formation of central Washington, by the apparently similar relations of these two formations to the Columbia lavas, and by the induration of the Dalles beds, which is equal to that of lower or middle Neocene deposits of the west, but much greater than that of Quaternary formations

In interesting papers by J H Bretz and by I A Williams the "Satsop" in the Columbia River Gorge has been considered Quaternary by correlation, mainly through lithologic similarity, with the fossiliferous marine Satsop on the Washington coast In the eastern part of the gorge, however, the writers have found the "Satsop" gravels beneath the Dalles beds Moreover, the "Satsop" gravels can be traced into central Washington where they lie at the base of the middle Neocene Ellensburg formation Further, the induration of the "Satsop" is considerably greater than that of other Pacific Coast upper Pliocene or Quaternary strata. For these three reasons the "Satsop" of the gorge is also believed to be approximately upper Miocene or lower Pliocene rather than Quaternary

Since the "Satsop" of the gorge is not the correlative of the type Satsop on the coast, the new name, "Hood River Formation," is proposed for these rather unique conglomerate and sandstone strata. The type section may well be the beds so excellently exposed in the cut immediately east of the Columbia River Highway bridge across Hood River

A more detailed statement of the evidence and of the bearing of these beds on the geological history of the region is in course of publication

JOHN P BUWALDA
BERNARD N. MOORE
CALIFORNIA INSTITUTE OF TECHNOLOGY

MORE DATA

UNDER "Datum and Data" in the July 1 issue of SCIENCE, Mr Blake says that "We speak and hence write English by ear and not by rules of grammar," and that "in ordinary use," data is not the mere plural of datum It was, no doubt, recognition of these very unfortunate conditions that prompted the commendable letters of protest regarding the use of "data" in the singular.

There is no standard in the education of ears, and thus it becomes very difficult to eliminate "ain't" from spoken English The old dictum that use is the law of language presupposes *good* usage, and the best existing criterion of good usage is a good dictionary. No reputable dictionary admits, or is likely to admit, "data" as a singular form

But the correspondence which I have seen regarding the misuse of "data" entirely overlooks the chief abuse, which consists, not in using the word incorrectly as a singular, but in using it at all when the intended meaning can be more accurately expressed otherwise Any one who cares to observe will find that, in probably nine cases out of ten, clearness can be gained by the substitution of "facts," "figures," "records," "values," "results," "information," or any one of perhaps a dozen other words which may more aptly fit the particular case. The general use of "data" for all such cases is due to the same slovenly thinking which causes a writer to use "etc" when he is at a loss for another word; or to use such expressions as "in regard to same" instead of repeating, or specifying just what he means by "same."

The laudable desire to adopt "new" words is to a considerable degree offset by failure to see that they are used accurately, and "data" is only one of a large number used erroneously more often than correctly. Though its use in the singular offends the intelligent

reader, the context usually reveals the true meaning This seems to be less often true in the case of "strata" (used less frequently, but with at least as high a percentage of error) The same desire for new expressions fills our reading matter with such words as "résumé" (for which "summary" is usually better) and "rôle," printed (newspaper style) without accents

Strangely enough, many a worker who conducts his investigations with the strictest accuracy of which science is capable, publishes his results with little concern for accuracy of statement or nomenclature Unfortunately, some of the errors escape the attention of even the most vigilant editor. A flagrant error which seems to be gaining ground is the expression "different than" Only two weeks ago it occurred in the *Saturday Evening Post*—one of our most carefully edited journals

E H McCLELLAND

CARNEGIE LIBRARY OF PITTSBURGH

ASSIMILATION OF FIXED NITROGEN BY HAVANA TOBACCO

EXPERIMENTS on the assimilation of different forms of combined nitrogen by Havana tobacco are being made at the Massachusetts Agricultural Experiment Station Among results to date is the proof of ready assimilation of ureal nitrogen in the unchanged form Plant growth, however, has not been as rapid with urea as a source of nitrogen as with sodium or calcium nitrate.

A more detailed report of the whole experiment will be made later On account of the growing importance of urea as a commercial fertilizer, we make this progress report

A B BEAUMONT
G J LARSINOS

STANDARD MATHEMATICAL SYMBOLS

A LIST of proposed American standard mathematical symbols has been prepared by a special committee of the American Engineering Standards Committee and the list has been submitted to the sponsor organizations This list was noted in SCIENCE for August 12, 1927 It has been published in full in the following places *Jour Engin Educ*, June, 1927; *Jour Soc Auto Engin*, July, 1927, *Mechanical Engineering*, August, 1927 Since the American Association for the Advancement of Science is one of the sponsor organizations for this standardization project, the permanent secretary wishes to bring this matter to the attention of all members interested, with the request that they examine the list and send him their comments as soon as possible. The comments received will be placed before the executive committee of the association, which is asked officially to approve the list of proposed standard symbols

BURTON E. LIVINGSTON,
Permanent Secretary

QUOTATIONS

A PORTRAIT PAINTER OF BIRDS

THE birds have lost their most devoted and faithful portrait painter in the tragic and untimely death of Louis Agassiz Fuertes For he was not only a great ornithologist He was for the birds what such an artist as Sargent was for men There are not a few artists who have represented with more or less accuracy the color, form and pose of birds, but the portraits painted by Fuertes, who had a genius for individualizing every bird he saw even in its facial expression and in depicting what he saw with practiced vision that was as a sensitized plate, also revealed the character of the living creature All birds of a feather look alike to the ordinary observer, but every owl and toucan painted by Fuertes, as Frank M Chapman said in writing of him many years ago, had its individuality, was instinct with life, and differed from the drawings of the inexperienced or unsympathetic artist as a living bird from a stuffed one

Dr Fuertes's opportunities for field study were greater than those of any other painter of birds, from the boreal birds of the Bering Sea to the flamingoes of the warmer regions He studied the birds of Texas, California, Nevada, Jamaica, the Gulf of St Lawrence, the Bahamas, Florida, Saskatchewan, Alberta, Yucatan, Mexico, Colombia and Abyssinia. He made thousands of drawings, many of which have been widely reproduced and have been of the greatest value in interesting the public, children especially, in bird life, and acquainting them with the characteristics, the habits and the migrations of birds and their relation to human life

But the contribution that will be his permanent monument in this state is his collection of portraits of the birds of New York (made for the illustration of Eaton's great work on the "Birds of New York"), which was purchased by Mrs Russell Sage and presented to the State Museum at Albany The birds will come and go with the seasons through the years all unwitting of his absence, but they can not become wholly extinct, for they will be preserved there as in life. He whose skill has given them this sort of immortality, in season and out, needs "no trophy, sword or hatchment o'er his bones," for they in turn will preserve the memory of his genius and of his devotion to them —*The New York Times*

SOME LIMITATIONS OF WARBURG'S THEORY OF THE ROLE OF IRON IN RESPIRATION

THE construction of models of biological processes has occasionally contributed greatly to the knowledge of the mechanisms of vital phenomena However, enthusiasm over the successful construction of a model that in part duplicates the reaction of living protoplasm often obscures the fact that the duplication is only partial and misleads the investigator into undue dependence on deductive reasoning Caution must be observed in accepting theories of the organism derived from the behavior of models, for in attempting to isolate a single process in this manner the controls and correlations that distinguish the living from the non-living are lost Obviously, the value of any theory derived from the behavior of a model depends on the extent of resemblance between the behavior of the non-living system and the facts and characteristics of the process of the living organism which it purports to simulate

An examination of the characteristics of biological oxidations shows that the comprehensive theory of Warburg of the mechanism of oxidations in the cell,[1] based largely upon the characteristics of his so-called models of respiration, is not free from the criticisms that have been levelled at other theories of biological processes similarly derived from models On the contrary, the divergence between Warburg's theory and the actual facts is wide enough to justify regarding the theory as distinctly limited in application

Briefly, Warburg has developed a theory of cellular oxidations in which iron in unknown combination with nitrogen is held to play the rôle of catalyzer Molecular oxygen is said to enter into combination with the iron to form higher oxides of iron, and the iron-nitrogen is assigned the property of adsorbing and peculiarly loosening the bonds of amino acids in the cell In the oxidation of carbohydrates phosphates replace nitrogen, and in the oxidation of fats the presence of the SH group is necessary A transfer of active oxygen is thus effected, and the iron is returned to a lower oxide Unfortunately for the theory in its present form, the facts of cellular oxidations which Warburg cites in support of his theory are in some important details disputable

The theory demands, and Warburg has shown in the case of the unfertilized sea urchin egg,[2] that the oxygen absorption of disintegrated cells is equal to that of intact cells. This is contradictory to sound evidence[3] which shows that the chief energy-releasing oxidations in the cell are profoundly depressed by mechanical destruction of the cellular structure. This contradiction between the findings of Warburg and those of others shows that the experimental result which Warburg uses in support of his general theory is not a general but a particular case The peculiar structure of the cell has thus been shown to be of great importance in its energetics Warburg himself years ago[4] demonstrated the importance of the cell boundary in regulating oxidative metabolism when he showed that dilute sodium hydroxide accelerates the oxygen consumption of the sea urchin egg without entering the cell interior

According to Warburg, anesthetics decrease oxidations in the cell because they are adsorbed by the iron-nitrogen, and are therefore described as general negative catalyzers of this reaction However, there is abundant evidence[5] that dilute solutions of many anesthetics accelerate oxidative metabolism The powerful action of the cyanides in depressing oxidative metabolism, Warburg asserts, strongly supports his theory The validity of this evidence is open to question Within certain limits the depression of oxidative metabolism in cyanide solutions increases with increasing concentration of the cyanide, but, after maximum depression characteristic of the concentration has been reached, continuous exposure does not result in further depression of oxidations Warburg holds that the action of cyanide in depressing oxidations in protoplasm is due to its combination with iron, converting it into a form incapable of transferring oxygen He regards the reaction between the cyanide and the iron as stoichiochemical, and he shows that the activity of an iron-nitrogen model in oxidizing an amino acid is depressed 97 per cent by the addition of M/1000 HNC According to this, we should expect very complete extinction of oxygen metabolism in the presence of strong cyanide The expectation is not realized It has been shown that M/1000 and M/2000 KNC have approximately the same effect on oxygen consumption in

[1] Warburg, O, 1921, *Biochem. Zeitschr*, cxix, 134, 1923, *ibid*, cxxxvi, 266, 1923, *ibid*, cxlii, 518, SCIENCE, n s, 1925, lxi, 575

[2] Warburg, O, 1911, *Zeitschr f physiol Chem*, lxx, 413, 1914, *Arch f ges Physiol*, clviii, 189

[3] Fletcher and Hopkins, 1907, *Jour Physiol.* xxxv, 247, Harden and Maclean, 1911, *Jour Physiol.*, xliii, 34, Batelli and Stern, 1914, *Biochem. Zeitschr.* lxvii, 443, Lund, E J, 1921, *Amer. Jour Physiol*, lviii, 336. See also discussion in R S Lillie's book, "Protoplasmic Action and Nervous Action," Chicago, 1923, page 52, *et seq*

[4] Warburg, O, 1910, *Zeitschr f physiol. Chem.*, lxvi, 305

[5] Lillie, R S, 1916, *Biol. Bull*, xxx, 311 and references, Buchanan, J W., 1923, *Jour Exper. Zool*, xxxviii, 331 and references.

Planaria dorotocephala, and although M/1000 KNC is lethal within a few hours, there still remains an oxygen consumption of about ten per cent of the normal to be accounted for[6] In Planaria agilis and in certain molluscan tissues the remaining oxygen consumption after maximum depression by cyanide is twenty per cent of the normal[7] Suitably diluted solutions of the cyanides appear to accelerate metabolism and in one case at least relatively strong solutions are required to depress cellular respiration[8] It is also true that an oxidative enzyme has been isolated, the activity of which is not appreciably affected by cyanide[9] The wide discrepancy between the theory and the observed facts is obvious Cyanide is therefore not a "specific negative catalyst" in the strict sense that Warburg's theory requires

A slight recovery of oxidative metabolism in the presence of cyanide has sometimes been noted This, Warburg says, is due to the oxidation of the cyanide itself by the catalytic action of the iron-containing substance Since the cyanide is said to render the catalyst incapable of transferring oxygen, a reasonable doubt arises that a catalyst can be instrumental in oxidizing a substance that has rendered it incapable of catalyzing an oxidative reaction

The writer has recently studied the recovery period after depression by KNC more intimately than has been done heretofore.[10] When Planaria are removed from a solution of KNC in which their oxygen consumption has been depressed fifty per cent, the oxygen consumption rises above the normal during the first hour after removal from the cyanide The extent of rise above normal is considerable, is independent of the duration of depression of KNC and persists, with gradual decrement, for at least six hours To bring Warburg's theory into alignment with these facts it is necessary to assume that the quantity of active iron or of oxidizable materials in the cell increases during the period of depression However, the fact that the extent of rise in rate of oxygen consumption above the normal is independent of the duration of depression renders these assumptions exceedingly improbable A third assumption is possible, namely, that the catalyst, after being freed from the cyanide, becomes excessively active Concerning this possibility there is no information available

[6] Hyman, L. H, 1919, *Amer Jour Physiol*, xlviii, 340

[7] Allen, G D, 1919, *Amer Jour Physiol*, xlviii, 93, Gray, J, 1924, Proc Roy Soc, Ser B, xcv, 95.

[8] Hyman, L. H, 1919, *Amer Jour Physiol.*, xlviii, 340, Townsend, 1901, Md. Agri. Exper Sta Bull, No 75, 183, Lund, E. J, 1918, *Amer Jour. Physiol*, xiv, 365, 1921, *ibid.*, lvii, 336.

[9] Dixon and Thurlow, 1925, *Biochem. Jour*, xix, 672.

[10] Buchanan, J W., 1926, *Jour Exper. Zool.*, xliv, 285

Why anhydrous conditions are necessary for the action of the iron catalyst in commercial nitrogen-fixing processes or why the reaction is strongly inhibited by minute quantities of carbon monoxide and other impurities is unknown, despite the vast amount of research that has been expended. The oxidative reactions in the living organism go on in a much more complicated system Warburg's emphatic postulation regarding the action of cyanide on the system may be considered premature

From the effects of cyanides on oxidation in living systems it is perfectly clear that the resemblance between Warburg's models and the oxidative mechanisms in the cell is distinctly limited As Warburg states, the idea that iron is of importance in oxidative metabolism is not new Warburg's results have yielded suggestions as to the possible nature of the rôle of iron However, the universality of iron in biological oxidative mechanisms is not proven, and his theory as at present formulated is quite inadequate to explain many of the facts that are associated with changes in rate of oxidations in the living organism

J WILLIAM BUCHANAN
OSBORN ZOOLOGICAL LABORATORY,
YALE UNIVERSITY

SPECIAL ARTICLES

VISIBLE RADIATION FROM EXCITED NERVE FIBER THE REDDISH BLUE ARCS AND THE REDDISH BLUE GLOW OF THE RETINA

THERE is a singular phenomenon—one of the countless interesting entoptic phenomena discovered by Purkinje[1]—which has remarkable consequences In a perfectly dark room you give yourself a band of red light—any light of the spectrum, and white light as well, will give the phenomenon but it is rather more easy to obtain with red light What you will see is not only the band of red light, but also stretching out from it on both sides big slightly reddish blue arcs—the bigger the further away you stand. They are not of the color of the rod pigment (visual purple), which is of a slightly bluish red The angular size and the shape of these reddish blue arcs make

[1] Purkinje "Beobachtungen und Versuche zur Physiologie der Sinne," 1825, ii 74 This rare work of Purkinje—so rare that Gertz reproduces the whole discussion which Purkinje gives of this phenomenon because so few of his readers will be able to see his book—has now been reproduced in Czecho Slovakia Purkinje, Johann Evangelista, *Opera Omnia.* Praze C Calve, 1919 My name for this phenomenon, "the reddish blue arcs" and "the reddish blue glow of the retina," has been very generally accepted.

it absolutely certain that what you are seeing is the fibers of the optic nerve which lie on the surface of the retina Since the beautiful work of Vogt with blue-green (red-free) light[2] these fibers can be plainly seen in any one's eye with the aid of the ophthalmoscope; until now they had only been seen by the anatomist and by means of the entoptic phenomenon here described

But why are these fibers visible? The explanation hitherto given, by Gertz and by others, is that the action current of the optic nerve fibers which carry the red light excitation causes a "secondary excitation" in adjoining fibers. Such a nerve current as this, however, if it occurred, would not be provided with the right "place-coefficients";[3] no adjoining fibers, though stimulated, would enable you to actually "see" the nerve fiber in question, for they would have the place-coefficients of those rods or cones from which they come It is with nothing but rods or cones, or bipolar cells, or ganglia, that the "seeing" of these reddish blue fibers could be done

But there is an additional feature of this phenomenon which throws great light upon its nature it is followed by an after-image. It has been shown by Lazareff[4] directly (what was perfectly well-known before) that any production of a light sensation (whether chromatic or achromatic) due to the passage through the head of an electric current is followed by no exhaustion, the nerve is like the heart and the organs of respiration—the refractory period suffices for complete restoration. When, however, exactly the same sensation is brought about by the action of physical light upon the retina there is extreme exhaustion, as measured by the Nagel adaptometer. But what is exhaustion in the light-sensitive substance in the rods and cones? It is merely another name for the after-image[5] The specific residual image that follows, a whitish reddish blue sensation, would be in color a less bright yellowish green A person who gets this after-image says at once "It is a dark olive," which is correct both as regards brightness and chromatic quality This fact excludes the possibility of any nervous structure whatever being the thing which is directly acted upon by the "blue arcs." Of this the experiment of Lazareff (*loc. cit.*) is absolute proof. His experiment is this: it is found that exactly the same visual sensation (say a slightly reddish blue) can be produced (1) by physical light and (2) by an electric current, but that in case (1) there is extreme exhaustion (and a residual image), and that in case (2) there is no exhaustion (and no residual image) What can be the cause of this extraordinary difference? The sensation (and therefore the cortical process) is the same in both cases All the conducting nerve-fibers are certainly stimulated in both cases But there is the possibility of a difference in what takes place in the retina

(1) There is no question that in the case of the physical light stimulus it is the light-sensitive substance in the cones (and the rods) that is acted on, and that it is the photochemical products of the dissociation produced by light that act then on the nerve-ends in the cones and rods If the electric current acted on the light-sensitive substance (as it is hard to think that it could—it has not got the excessive specificity of the visible radiations) then there would be no possible difference between the two situations, and there could not be (1) the existence of the residual image in the one case, and (2) its non-existence in the other Hence we must conclude that (1) with the existence of the residual image goes the stimulation by physical light and (2) with the *non-existence of the residual image goes direct stimulation* of nerve by the electric current. The "blue arcs" and the "blue glow" which belong in the case of the after-images make themselves seen therefore by physical light and not by any sort of a "secondary excitation"

But this is not so strange a situation as it appears to be at first sight. There is another case in which visual sensations of all kinds are produced, but without any residual images—that in which the optic nerve is directly stimulated by pressure There are several (no less than six) different forms in which pressure can be applied to the optic nerve·

(a) The "pressure phosphenes"—rings produced by pressure with the finger on the corner of the eye

(b) Light-sensations (all the colors of the rainbow) produced by pressure with the hand on the whole eyeball. (This is dangerous.)

(c) What I have called the pull-phosphenes (got by moving the eyeballs vigorously to one side and the other) One sees the exit point of the optic nerve.

(d) The so-called "self-light of the retina." This is now believed to be due to permanent pressure on the retina by the fluids of the eyeball.

(e) After a fall on the ice, if one hits the back of the head, one "sees stars."

(f) In case of enucleation of the eyeball, at the

[2] Handb der biol Arbeitsment, 1922, Abt. V, Lief 55, 376

[3] It has been necessary to introduce this new term; without it we have nothing but the wholly erroneous "local sign"

[4] Lazareff, *Comptes rendues de l'Académie des Sciences*, 178, 1100, 1924

[5] I have introduced the terms "persistent image" and "residual image" for positive after image and negative after image, respectively They save the tired brain, in each case, one unnecessary syllogism

moment when the optic nerve is cut there is a visual sensation. (J J. Abel)

In the last two cases, no residual image has *ever* been observed; in the other four cases it is perfectly well known that there is no residual image. Stimulation by the electric current then falls into the same category with stimulation by pressure—the optic nerve (or *some* part of the nervous structure—the cortex itself is sufficient—see Fedor Krause[6]) is acted on directly, while in the case of chromatic stimulation by light it is the highly specific light-sensitive substance in the cones that is acted upon photochemically

In fact, it is any way plain that this light-sensitive substance in the cones (the *Sehstoff*[7]) has been made highly specific in order to respond *specifically* to the 160 energy-radiations in the spectrum which we can distinguish as different sensations. There is no such specificity as this in an electric current—hence one could have predicted that it could not attack the light-sensitive substance directly

There are additional considerations:

(1) The optic nerve-fibers are non-myelenated, but occasionally there occurs a congenital defect of myelenated fibers in this region of the retina I have had such a case and this individual did not see the blue arcs

(2) In a case of traumatic blue-blindness, the blue arcs were seen, while there was no blue sensation from external objects. But blue blindness, even when congenital, is nearly always a retinal defect and traumatic blue-blindness is known to be due to yellowish exudations on the surface of the retina. This would prevent blue light coming through from external objects, but would not prevent the reddish blue fibers underneath it from being seen by the cones

(3) Since it is known (a) that nerve, when excited, gives off CO_2 (Shiro Tashiro, G H Parker), (b) that it gives off heat which, though excessively small in amount, can be measured (A. V. Hill, *Proc. Roy Soc.*, 1927) and (c) (more important still) that every organic substance (if of high vitality) gives off radiations which enable it to take its own photograph (A Nodon, *Comptes rendus*, 1924, 178, 1101) it is no far cry to suppose that nerve (especially when stimulated, but perhaps also when not stimulated) can give off radiations which are *visible* by means of the human rods and cones close by

(4) But if this is the case, why has it not been discovered before, since physiologists are always working with stimulated nerve-fibers? The answer is: They do not so often work with non-myelenated fiber.[8] Moreover, they do not work in an absolutely dark room, that is necessary to seeing this phenomenon

(5) The blue glow (seen by hardly any of the (twelve) observers who have written on this subject since Purkinje) is due to the visibility of the point-like (when seen in cross-section) bipolar cells which surround the red band.

The argument then stands thus: Nothing but the light-sensitive substance in the rods and cones can furnish an after-image, and this can be affected by nothing but physical light, consequently, when the observer sees the reddish blue arcs (and the reddish blue glow) of the retina he is actually "seeing" his own optic nerve-fibers (and bipolar cells)

I have set out my argument very fully here because, though it is really quite irrefragable, some of my readers[9] have seemed to find it difficult to follow. I have defended this view of the blue arcs and the blue glow (at Woods Hole and elsewhere) for some six or seven years. The recent work of Lazareff and Nodon, while it is delightfully to the point, is not at all essential to my proof it has been well known since 1899 (S. I Franz, *Psychol Monographs*, Fedor Krause, *loc cit.*) that visual sensations due to the electric current are not followed by an after-image[10] and so belong to a very different category from visual sensations due to physical light[11]

CHRISTINE LADD-FRANKLIN
COLUMBIA UNIVERSITY

[6] *Klin Wochenschr*, Jg. 3, p 1269, 1924.

[7] This is apparently *not* the rod-pigment, the visual purple (as some suppose it to be), for the (white) brightness distribution in the extreme periphery (where there are rods only) is, in photopic vision, the same as in the centre of the retina (v. Kries).

[8] Hallowell Davis, *Physiological Reviews*, 1927, p 583 —I tried to see objectively if any light was given off by the splanchnic nerve of a dog when stimulated in a dark room by an electric current But one would not expect a light so faint as this must be (A. V. Hill) to be seen at any distance, although it is visible to the rods and cones close by Besides, the dog I tried was not of high vitality—it had, for several hours, been the subject of vivisections.

[9] *Proc. Nat. Acad of Sciences*, 12, 413, 1926

[10] Any more than sensations due to pressure

[11] It is a singular fact—hitherto unexplained as far as I have been able to find out (but one which ought to throw great light upon the nature of the nerve impulse) —that the light sensation produced by the electric current (galvanic) is of opposite ("complement") colors according to the direction in which the current flows, and also with the make and the break of the current [circuit?]. The colors are reddish blue and greenish-yellow. This has led ardent followers of Hering (G. E. Müller and others) to think that our after-image is in some way involved in this—but without sufficient reason

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE SOUTHWESTERN DIVISION

THE Eighth Annual Meeting of the Southwestern Division of the American Association for the Advancement of Science was held at the Art Museum, School of American Research, Santa Fé, New Mexico, on April 12, 13, and 14 Although the numbers attending (73 were registered) were not large, the institutional representation, from Colorado, Arizona, New Mexico and western Texas, was excellent Programs were given by the sections on biological sciences, social sciences, physical sciences and education An outstanding event of the sessions was Dr Edgar L. Hewett's report of an "Archeological Reconnaissance in Northern Africa," which was given at the general session in the St Francis Auditorium of the Art Museum on the evening of April 12 An important point brought out was the disastrous effect of the careless cutting of forest and the elimination of plant cover in that region This thesis was carried further as applied to our own Southwest in a notable paper by C K Cooperrider, U S Forest Service, on "Semi-Arid Range Lands of the Southwest an Economic Asset or Liability to Future Generations," which was presented in the symposium on forest and forage crops held under the auspices of the Section on Biological Sciences April 13 G A Pearson, director of the Southwestern Forest Experiment Station, in discussing "Some Basic Relations between Grazing and Forestry," pointed out the detrimental effect of sheep-grazing in the yellow pine type in the Southwest and the need for rigorous regulation In the Physical Sciences Section the planet Mars came in for consideration by the industrious staff-members of the Lowell Observatory, and geographical, geological and electrical topics were dealt with by other eminent physicists of the Southwest President A O Bowden's (New Mexico State Teachers' College) emphasis on education for use, and D W Rockey's discussion of "Pressing Problems in Rural School Sanitation" were among the outstanding papers presented in the Section on Education The attractiveness of the Southwest as a field for archeological and ethnological study was abundantly demonstrated by different speakers in the Section on Social Sciences The address of the retiring president of the Southwestern Division, Mr A L Flagg, of Phoenix, Arizona, on "The Search for Metals," was given at the general session April 13 At the business session a code of ethics for scientific workers was proposed by the division's committee on the social and economic welfare of scientific men. The code was unanimously adopted and has been transmitted to SCIENCE[1] for publication Dr J G Brown, of the University of Arizona, and Dean O. C Lester, of the University of Colorado, were elected to the executive committee of the division Another vacancy on this committee was later filled by the appointment of President A O Bowden, of the New Mexico State Teachers' College A committee composed of Francis Ramaley, University of Colorado, R B Streets, University of Arizona, Walter G Sackett, Colorado Agricultural College; G A Pearson, Southwestern Forest Experiment Station, and Walter P Taylor, U S Biological Survey, was appointed to revise the constitution of the division Lansing Bloom, of the Art Museum, School of American Research, Santa Fé, was named president of the division for the ensuing year. Dr Forrest Shreve, Carnegie Institution of Washington, holds over as vice-president and chairman of the executive committee Walter P Taylor was named secretary-treasurer of the division, and William G McGinnies, University of Arizona, assistant secretary Newly elected officers of sections are: Physical Sciences Section C O Lampland, Lowell Observatory, *Chairman*, R S. Rockwood, University of New Mexico, *Secretary*; Section on Education, D W Rockey, Director of Vocational Education, New Mexico, *Chairman*, Samuel Burkhard, State Teachers' College, Tempe, Arizona, *Secretary*, Section on Social Sciences, Byron Cummings, University of Arizona, *Chairman*, Odd S Halseth, School of American Research, *Secretary*, Biological Sciences Section, J. J Thornber, University of Arizona, *Chairman*, William G McGinnies, University of Arizona, *Secretary*, Medical Section, Dr Elliott C Prentiss, El Paso, *Chairman*

The courtesy and hospitality of the School of American Research, through the Art Museum, of St. John's Methodist Episcopal Church, the Kiwanis Club, the Scottish Rite Association of Santa Fé and others who helped to make the meeting so successful and enjoyable were much appreciated by all the members

The ninth annual meeting of the division will be held at Flagstaff, Arizona The date has not yet been set.

WALTER P TAYLOR,
Secretary

[1] SCIENCE, July 29, p 103.

SCIENCE

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IRA REMSEN

Two men, Ira Remsen and Wilhelm Ostwald, stand out during the last fifty years as great teachers and as founders of chemical journals which have had a profound influence on the development of chemistry. In these two respects their work is comparable with that of Liebig during the middle of the nineteenth century.

Ira Remsen was born in New York City, February 10, 1846. His parents were both descended from the early Dutch settlers of New York and his mother had also Huguenot blood in her veins. For two years, from eight to ten, the boy lived in the country and had that intimate contact with nature which is impossible for a lad who spends his life exclusively in a city. A part of his early education was received in country schools. After further study in the public schools of New York City he entered the Free Academy, now the College of the City of New York, where he studied Latin, Greek, mathematics, history and a very little science. He did well in Latin and Greek and it was doubtless during those years that he laid the foundation for that perfect command of accurate English which has made it such a delight to read his books and to listen to his lectures. His interest in science seems to have been awakened at this period by the popular, illustrated lectures given by Dr. Doremus at the Cooper Institute.

He did not, however, complete the four years of work required for graduation at the Free Academy. Many years later he received the bachelor's degree from the College of the City of New York, as of the class of 1865. He was accustomed to say, with some pride, that he was one of the few men who had received the rank of M.D. from the College of Physicians and Surgeons without having received the bachelor's degree. He also said, at one time, that he thought he was the only university president in America who had not completed a four years' college course.

After a few years in the Free Academy, Remsen's father decided that he should become a physician and apprenticed him to a doctor who taught in a homeopathic medical college. Here he read some chemistry and tried some chemical experiments for himself, sometimes with disastrous results to his fingers and clothing, as he told his students in recalling these days. He attracted the attention of his preceptor, however, and was made lecture assistant and quiz instructor in the college.

He soon revolted at the inefficient instruction and induced his father to send him to the College of Physicians and Surgeons of Columbia University. At the age of twenty-one he graduated and was supposed to be ready for the practice of medicine.

Once more he refused to be guided by the wishes of his father and, instead of entering a desirable partnership, which was offered him, with a well-known physician, he set out for Germany to study chemistry.

Liebig's name had attracted him to Munich and he had not learned that the great master had given up the direction of students some time before and had gone to the Bavarian University with the understanding that he could devote his time to his own studies and writing and that his duties should consist in giving a single course of lectures in inorganic chemistry. Remsen was forced to study with an able *Privatdocent*, Jacob Volhard. From him he received his first systematic laboratory instruction. Before that he had never performed the simplest analysis. Thorough training in analytical chemistry was, at that time, considered to be the only routine laboratory work necessary for the preparation of a chemist to begin research, and we may be sure that the fundamental basis for his career was well laid during this year of intimate association with Volhard.

During the summer of 1868, Wöhler made one of his friendly visits to Liebig and through Volhard, Remsen was introduced to him and arranged to go to Göttingen in the fall. There he began research work under the direction of Fittig and two years later received his degree of Ph.D. at the age of twenty-four. When we remember that Remsen spent only one year in the systematic study of chemistry and two years in research in earning his degree, we are tempted to question whether the long years of routine instruction which are required of young chemists to-day do not tend to dim that eager enthusiasm and repress the initiative so invaluable for a successful career.

It does not follow, however, that because Remsen did not take the varied courses of routine lectures which we expect of students to-day he failed to become very thoroughly acquainted with the chemistry of his times. He once told me that during his stay in Germany he read the volumes of Liebig's *Annalen*—150 volumes had been published in 1870—until he was acquainted with all the important papers published in that journal.

The same year that Remsen received his doctor's degree, Fittig was called to the professorship at Tübingen and he asked Remsen to go with him as his lecture and laboratory assistant. He continued in this position for two years and in this way, for five years in all, he drank in the spirit of the German laboratories.

It was a fortunate time for the eager, enthusiastic young man. In 1858 Cannizzaro had shown the importance of Avogadro's principle and laid the foundation for a system of true atomic weights. The same year, Couper and Kekulé extended Frankland's doctrine of valence to explain the structure of carbon compounds, and hundreds of professors and students were working together, after the model of Liebig's laboratory, in the fascinating world of organic chemistry.

It was at Tübingen, too, that a young Scotchman rang at the door one day and asked, in broken German, for the "Vorlesungszimmer." Remsen answered, "Oh! I guess you want the lecture room." So there was begun the life-long friendship with Sir William Ramsay. Only a few months before his death, Sir William wrote to Remsen, "Well, I am tired and must stop. I look back to my long friendship with you as a very happy episode in a very happy life; for my life has been a very happy one." When Remsen helped with the plans of the Kent Chemical Laboratory of the University of Chicago, he provided few rooms for isolated students and he made the remark that students learn more from each other than from their teachers. When two such students as Ramsay and Remsen met, we can well believe that this was true.

Remsen returned to America in 1872 and, after some delay, was appointed professor of chemistry and physics at Williams College. When he assumed his duties he found no laboratory and scant encouragement to teach science other than as a small element of general "culture" in an old-fashioned classical college. After a year, he was furnished a laboratory for his own use and there he carried on researches on the action of ozone on carbon monoxide—a subject to which he returned some years later—and on parasulfobenzoic acid. The latter led to an attempt to oxidise orthosulfobenzoic acid and its sulfamide and this, in turn, led to a long series of investigations carried out with students at the Johns Hopkins University. These studies finally established "Remsen's Law" that groups in the ortho position interfere with the oxidation of alkyl groups of aromatic compounds by means of chromic or nitric acid.

As an illustration of the spirit of the New England colleges of that day, the following incident related by Professor J. M. Kingsley is illuminating:

In the autumn of 1874, together with the rest of the junior class in Williams College, I began the study of chemistry under Professor Ira Remsen. After a few days I asked him for the privilege of carrying my studies farther in his private laboratory, as there was no laboratory work connected with the regular course. He replied to the effect that he would have to lay my request before the faculty, as there was no provision for such work in

the curriculum. A few days later he asked me to stop after the class was dismissed, and then he informed me, in the most disgusted tones, that "The Faculty, *in their wisdom*, have decided that you would break too much glassware and waste too many chemicals to allow you to work in my laboratory"

Kingsley became a zoologist of note instead of a chemist.

Shortly after his return to America, Remsen published a translation of Wöhler's "Organic Chemistry" He also published a beautifully written "Theoretical Chemistry." These books, and still more his persistence in research under discouraging conditions, attracted the attention of President Gilman, who was seeking men for his faculty at the Johns Hopkins University. He had already secured Gildersleeve for Greek, Rowland for physics and Sylvester for mathematics. Remsen was invited to Baltimore to meet the Board of Trustees and was entertained at a dinner at which he was seated beside one member of the board after another. In this way Professor Remsen became one of that galaxy who worked with President Gilman to organize the first genuine university in America, where more than half the students were graduates of other colleges and where the purpose was not so much to teach what is already known as to develop men into productive scholars and add to the world's knowledge. President Gilman had the somewhat rare quality of fully trusting the men he selected and allowing them to develop the work of their departments without interference. His injunction to Remsen was, "Do your best work in your own way"

Professor Remsen followed rather closely the models with which he had become so familiar in Germany. He gave lectures on inorganic chemistry during the first semester and on organic chemistry, the second These were well illustrated with experiments and he had a crystal-clear, masterful method of presenting his subject. Once a week there was a meeting of graduate students for reports on current literature.

But the most important and vital part of his instruction was the daily visit to the desk of each research student. Often, at critical points, he would stop and work for minutes or for an hour or more with the student, and the product, in the end, was the joint work of professor and student, as it had been in Liebig's laboratory. Most of the topics studied grew, directly or indirectly, from his investigation of the oxidation of para- and orthosulfobenzoic acid and the law of the protection of ortho alkyl groups from oxidation.

Quite early in the course of these studies, Fahlberg, working under his direction, discovered that the orthosulfamide of benzoic acid may be easily oxidised by potassium permanganate in a neutral or faintly alkaline solution. The product was called by Remsen benzoic sulfinide. It is several hundred times as sweet as sugar and some years later Fahlberg developed the commercial production of the compound under the name of saccharin.

The discovery of benzoic sulfinide naturally led to the investigation of many other similar compounds. This also led, rather directly, to the discovery of the sulfonephthaleins and the study of the chlorides of sulfobenzoic acid. Professor Reid reports how he came to study the decomposition of diazonium compounds with alcohol The laboratory book said "add alcohol and smell the aldehyde" A student came to him and said he did not smell aldehyde. Remsen took the tube and could not smell aldehyde either. He made this into a good story, telling how stubborn the student was who wouldn't smell aldehyde when told to do so.

The work of Professor Remsen and his students never degenerated into the mere preparation of new compounds. He always endeavored to establish some general principle in relation to the substances prepared.

In 1883 Professor Remsen came back to the action of ozone on carbon monoxide and a very careful investigation demonstrated that the latter is not oxidized when the mixture with ozone is heated to 300° and the ozone is completely decomposed. He also, in an investigation which proved that phosphorus usually contains a little carbon, demonstrated that carbon monoxide is not oxidized when mixed with air and passed over moist phosphorus, although ozone is formed in quantities. A satisfactory theoretical explanation of these remarkable results is still to be found.

In 1889 Professor Remsen made an exhaustive study of the literature of the double halides and found that, with very few exceptions, the number of mols of an alkali halide combined with one mol of another halide is equal to or less than the number of atoms of chlorine in the other halide. A considerable number of experimental investigations were carried out with his students to test the validity of this generalization. The conclusion that two chlorine atoms unite to form a bivalent group has not been generally accepted and does not agree well with the more recent electronic theories of chemical combination.

When Remsen went to Johns Hopkins University in 1876, there was no satisfactory medium in America for the publication of an account of his researches. A few of his articles were published in *The American Journal of Science*, but Professor Dana, the editor of that journal, soon decided that researches in organic chemistry did not furnish material of sufficient interest to his readers and advised publication abroad.

Professor Remsen was not satisfied with this and, with the aid of other chemists, he established *The American Chemical Journal* With far-sighted vision, he made this a medium of publication for American chemists and not an organ of the Johns Hopkins University For thirty-five years this journal was a very important agency for the promotion of genuine chemical work It was the first American journal in this field which secured widespread recognition abroad and it would be difficult to overestimate its value in stimulating chemical work and in placing Americans in their rightful place among the chemists of the world At the close of the fiftieth volume President Remsen decided that publication in America would be better served by incorporation of *The American Chemical Journal* with *The Journal of the American Chemical Society* This was done and the latter journal carries on its title page a record of the consolidation of the two journals.

Remsen's first book was a "Theoretical Chemistry," written while he was at Williams College It passed through five editions and was translated into German and Russian His "Organic Chemistry" was published in 1883 and has been the medium through which many chemists, physicians and others have been introduced to the subject His text-books of "Inorganic Chemistry," both elementary and advanced, are characterized by a logical, lucid style which has made them very popular and widely used The "Organic Chemistry" was translated into many foreign languages and several of the other books were also translated

A long series of students, trained in intimate association with Professor Remsen, are now widely scattered and many of them hold important positions as teachers and in the industries They look back to him as to a father, who always required high quality in their work, who was wise in his advice and helpful in their difficulties

Professor E E Reid writes, "It is impossible to characterize or describe Remsen He had a keen sense of humor and a ready wit, a personality in the fullest sense of that term He drew people to him but always kept them in their place."

In 1881 Boston had trouble with her water supply and Professor Remsen was called upon for his advice. He was fortunate enough to discover the cause of the difficulty On many other occasions he was called upon for public services to Baltimore, Maryland and the United States. He was for some years a member of the Good Roads Commission of the state

In 1901 Remsen succeeded D C Gilman as president of Johns Hopkins University The resources of the university had been depleted by the depreciation of some of its securities and the period of his administration was a difficult one. In spite of this, the university continued its steady and satisfactory development The school of engineering was founded and the cramped quarters in the heart of the city were exchanged for the magnificent campus which the university now occupies in the outskirts of Baltimore.

President Remsen retired in 1913 After that he spent his time in travel, in revising his books, in work for the government as chairman of the Referee Board organized during Roosevelt's administration to consider questions pertaining to the law for the control of food products and their adulteration, and in consulting work for one of our largest industrial corporations. He died at Carmel, California, in 1927, at the age of eighty-one

He was the recipient of many honors The degree of LL.D was conferred by Columbia, Princeton, Yale, Toronto, Harvard and Pennsylvania. He was a foreign fellow of the London Chemical Society and foreign member of the French Chemical Society. In 1902 he was president of the American Chemical Society, in 1903, of the American Association for the Advancement of Science During 1907–13 he was president of the National Academy of Sciences. In 1908 he was awarded the gold medal of the Society for Chemical Industry and in 1910 was president of that society. In 1914 he received the Willard Gibbs medal of the Chicago Section of the American Chemical Society

In his boyhood Remsen was reared in a very strict, religious atmosphere and he retained a simple religious faith throughout his life In his address "On the Life History of a Doctrine," delivered as president of the American Chemical Society, after pointing out that "faith is called for at every turn in scientific matters as well as spiritual," he said, "It would be as illogical to give them (atoms) up as it is, in my opinion, to deny the existence of a power in the universe infinitely greater than any of the manifestations familiar to us, infinitely greater than man; a power that 'passeth all understanding'"

WILLIAM A NOYES

UNIVERSITY OF ILLINOIS

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE RENO MEETING OF THE PACIFIC DIVISION—II

AMERICAN PHYTOPATHOLOGICAL SOCIETY, PACIFIC DIVISION

(*T E. Rawlins, secretary pro tem.*)

The Pacific Division of the American Phytopathological Society met on June 23. The first paper, by W. T. Horne, discussed the fruit decays of the feijoa.

Botrytis cinerea Pers. was reported as the most common cause of decay in this fruit, with *Penicillium expansum* Lk. second in importance.

J. P. Bennett described a method of treating pear trees with ferric citrate for the control of lime-induced chlorosis

The addition of a small amount of peat soil to a fertile potting soil was reported by T E Rawlins to treble the early growth of celery in this soil; the possibility of this increased growth being due to the celery mycorhiza was discussed

Experiments reported by M. Shapovalov gave evidence that the western yellow tomato blight is transmitted by *Eutettix tenella* Baker. Typical disease symptoms were only produced under proper environmental conditions It was suggested that the name of the disease be changed to "tomato yellows." This change was approved by the society

H S Fawcett and W R. Barger reported that the maximum rate of decay of citrus fruits by *Penicillium italicum* and *P digitatum* was produced at temperatures between 66 8° and 80 6° F, temperatures above and below these limits being less favorable for decay In most cases the rate of decay was much more rapid at the stem-end than at the stylar end of orange fruits.

A paper by L J. Klotz on the enzymes of *Pythiacystis citrophthora* Sm and Sm reported positive evidence for the presence of the following enzymes in the mycelium of this fungus—lower esterases, diastase, invertase, maltase, emulsin, phloridzinase asparaginase, urease, peroxidase and catalase. An improved method of determining enzyme activity was described

F. N Briggs reported experiments in dehulling barley seed with sulphuric acid to induce infection with covered smut, *Ustilago hordei*.

Experiments on the influence of various environmental factors on the development of the curly-top disease of sugar beets were described by W Carter.

Botanical Society of America, Pacific Division

(*J. P Bennett, secretary, Berkeley, California*)

The Botanical Society of America held three half-day sessions on June 22 and 23. From 30 to 50 people were present at each session. Twenty-three papers were presented.

The following officers were elected for 1927–1928:

D R. Hoagland, *president;* University of California, Berkeley, California

G. M. Smith, *secretary;* Stanford University, California.

Ecological Society of America

(*A. G. Vestal, Secretary for the Reno meeting, Stanford University*)

The Ecological Society of America held a joint session with the Western Society of Naturalists, as fully reported by the secretary of that society It may be said here that the excursion to Pyramid Lake on Friday, in which all the ecologists attending the meeting participated, proved of unusual interest to the ecologists

Pacific Coast Entomological Society

(*E. P Van Duzee, secretary pro tem, San Francisco*)

The Pacific Coast Entomological Society met in the Agriculture Hall, with 37 members and visitors in attendance. In the absence of the regular officers of the society Mr E. P Van Duzee called the meeting to order and proposed Professor C W Woodworth as chairman *pro tem* Mr Van Duzee was asked to act as secretary for the meeting. There was no formal program, but Dr G Dallas Hanna gave a most interesting talk on his experiences in collecting insects in Alaska during the years he was engaged in government work there, and Dr Frank R Cole told of some studies he had made on the curious flies belonging to the genus *Diopsis*, and later also gave some account of the insect collecting he had done during his residence in Florida. A general discussion of these matters and notes by other members and visitors filled the time of the meeting.

San Francisco Aquarium Society

(*C J MacMeekin, secretary, Mill Valley, Calif*)

The San Francisco Aquarium Society held one joint session with the Western Society of Naturalists and participated in the excursion to Pyramid Lake.

Western Plant Quarantine Board

(*W. C Jacobsen, secretary, Sacramento, California*)

The ninth annual conference of the Western Plant Quarantine Board was held immediately preceding the regular sessions of the Pacific Division

This board was organized in 1919 at Riverside, California, under the leadership of Mr G H Hecke, the present director of agriculture for California Its territory includes the eleven western states, also Hawaii, the State of Lower California, Mexico and the Province of British Columbia, Canada

It was the first, hence the pioneer, regional plant quarantine board, of which there are now four cover-

ing the entire United States These four regional boards are further coordinated by the National Plant Board, a foster-parent in touch closely with national quarantine matters It is unique in that it incorporates in its membership representatives from territories outside of the United States

The Reno session of the board necessarily attended to matters of vital interest to the western area, involving similar plant quarantine action against pests found in other sections of the United States, discussion of uniform basic quarantine laws passed by recent legislatures and the harmonizing of state quarantines pertaining to quarantinable commodities moving between the several states and territories represented

Chairman Oscar Bartlett, state entomologist of Arizona, presented clearly the importance of detailed and careful inspections of vehicles crossing state boundaries as a means of preventing the introduction and spread of serious plant pests, also emphasizing the readiness of dangerous insects to enter from parts of Mexico unless a consistent and vigilant check is kept on all incoming plant commodities

The recent introduction of the Mexican fruit fly into Texas was discussed by G H Hecke, pointing out that this dangerous insect was the first representative of a group of seriously destructive *Trypetidae* to become established in the United States He clearly defined the menace presented and spoke of the importance of eradicating it and suppressing further spread by necessary quarantine action under the leadership of the Federal Horticultural Board

The determined attitude taken by Secretary Jardine in maintaining a rigid quarantine against Spanish grapes because of Mediterranean fruit fly infestation was commended

There were general discussions on the control of European earwig and insect pests of narcissus bulbs, the latter by Chas F Doucette and Dr Frank Cole of the U S Bureau of Entomology Other pests under consideration were Mexican bean beetle, alfalfa weevil, Colorado potato beetle, Thurberia weevil, and pink bollworm of cotton

An important feature of the meeting was the submission of detailed lists and reports on economic pests, both insects and diseases, in the various states represented in connection with the reports on quarantine conditions in each state during the year preceding

Two official representatives from the Mexican Department of Agriculture and Development, Dr. Alfons Dampf, chief entomologist, and Mr. Enrique Coppel Rivas, inspector general of fumigation and plant quarantines, indicated the progress being made in Mexico in the matter of pest detection and control, as well as detailed reference to the procedure in effect in the three west coast states of Mexico, namely, Sonora, Sinaloa and Nayarit, to prevent introduction of dangerous insects existing in other portions of the Republic of Mexico This area was, until the spring of 1927, quite isolated, but is now made more subject to pest introduction and distribution by the completion of a new rail line New regulations are in effect in Mexico against Mediterranean fruit fly hosts from foreign countries. The importance of their cooperation with our western states on the Pacific Coast was emphasized

To the end that there might be a better understanding between pest conditions in Mexico and in the United States and the relationship of adequate protection against the introduction into either from each of the countries of dangerous insect pests and plant diseases, there was recommended to the authorities at Washington the creation of an international crop pest commission to make careful study of the entire situation, its findings to be made available in an advisory way to the regularly constituted authorities in each republic

The value of uniformity in apiary inspection regulations and quarantines brought about the suggestion that a permanent committee be formed within the organization to bring about harmonious action as to quarantine regulations and uniform organization in the various states for the elimination of American foul brood

A standing committee on pest surveys was continued, as well as a committee on uniform treatments, this latter committee to investigate all methods of treating plant products either by sprays, fumigations, both atmospheric and in vacuum, various dips, dry heat and hot water treatments, etc, in order to determine if any feasible methods could be utilized to make safe the interstate and intrastate movement of pest hosts by secure treatments

The Western Plant Quarantine Transportation Committee, consisting of representatives of railway and express companies, was in attendance to aid in the correlation of pest prevention methods insofar as common carrier agents could assist

A further detailed discussion of the value of automobile inspection was presented by A. C. Fleury, of California, basing the same on one full day's interception of pests. Representatives of the Office of Blister Rust Control, C. R. Stillinger and S. N. Wyckoff, explained the program in effect to stem further spread of this disease of white pines through elimination of currants and gooseberries and by quarantine enforcement.

The officers elected for the ensuing year are

George G Schweis, *chairman*, entomologist, State of Nevada.
J I Griner, *vice-chairman;* horticulturist, Washington State Department of Agriculture, Olympia, Washington
M. L Dean, representative on the National Plant Board, director, Bureau of Plant Industry, Idaho Department of Agriculture
W C Jacobsen, *secretary*, chief, Bureau of Plant Quarantine and Pest Control, California State Department of Agriculture, Sacramento

WESTERN SOCIETY OF FARM ECONOMICS

(*P V Cardon, secretary, Logan, Utah*)

Farm economists of the eleven western states met with the Pacific Division on June 22 and 23, and perfected an organization to be known as the Western Society of Farm Economics The purpose of this society is to promote understanding among western farm economists relative to economic problems in the respective states, the methods used in studying these problems and the progress made toward their solution The association will aim also at coordination of effort wherever coordination is practicable

The society met in the Mackay School of Mines building of the University of Nevada, where they were welcomed by President Walter E. Clark President Clark opened the conference by outlining some economic problems involved in public land administration in the Intermountain Region The remainder of the first day was spent in a consideration of projects in agricultural economics as they were outlined by delegates of the states represented Suggestions for coordination of work and standardizing methods of investigation were offered by B H. Critchfield, of the U. S Bureau of Agricultural Economics

The program of the second day was as follows.

"Investigations in Farm Management," by George L Sulerud, University of Idaho, read by R. C Engberg, University of Idaho, discussion led by P. V. Cardon, Utah Agricultural College.

"Investigations in Cost of Production," by R. T. Burdick, Colorado Agricultural College, R M. Clawson, University of Nevada, and H. D. Scudder, Oregon Agricultural College.

"Marketing Problems," by R. L Adams, University of California, read by S W Shear, University of California.

"Factors affecting the Supply of Farm Products," by E Rauchenstein, University of California.

"Need of Statistical Measurements in determining and Correctly interpreting the Irrigation Situation," by Charles H. West, University of California.

"Collecting and disseminating Economic, Statistical and Marketing Information," by L. R Breithaupt, Oregon Agricultural College

Officers for the ensuing year are F B Headley, University of Nevada, *president*, H D. Scudder, Oregon Agricultural College, vice-president, P. V. Cardon, Utah Agricultural College, *secretary-treasurer*

WESTERN SOCIETY OF NATURALISTS

(*C V Taylor, secretary, Stanford University*)

The Western Society of Naturalists held its twelfth annual meeting on June 23, in affiliation with the Pacific Division As evidence of the continued activity of this biological organization, which alone is distinctly western in origin and representation, it should be noted that the day's program included reports of 20 investigations from eight different research laboratories The afternoon session was held jointly with the Ecological Society of America

In his paper, "Contribution to the Replacement of the Linnaean System of Nomenclature," Dr G Dallas Hanna said that the Linnaean system of binomial nomenclature of animals and plants, established in 1758, has been a constant cause of dissension ever since If we accept evolution as a fact we can not assume that all species were created as they now exist and will never change Nor can we consistently persist in the naming of such assemblages of individuals as we think have common ancestry We may as well admit that species in the Linnaean sense, created entities, do not exist in nature Therefore, in addition to dropping the genus as a part of the name it would appear to be advisable to define a species as an individual organism or part of an organism deposited in a public museum and to which a name has been given and duly published Supposed relatives of this specimen might bear the same name.

Professor S J Holmes, discussing "The Differential Mortality of the Negro," concludes that the American Negro is building up an increasing degree of immunity to two of the greatest scourges of the colored race—tuberculosis and pneumonia, further, that Negroes are less susceptible than the whites to scarlet fever, diphtheria, measles and various other maladies. Since, due to both an increasing immunity and improved sanitation, the birth-rate of the Negro, particularly in the north, may probably soon exceed the death-rate, the biological fate of this race is of prime importance in the eventual composition of the American people. In the long run, this question will likely be decided on the basis of differential mortality.

Dr. Laurence Irving reported results of recent studies on phosphoric acid changes in worked mam-

malian muscle. Acid-soluble inorganic phosphorus of cat muscle may be either increased or diminished by brief tetanic stimulation to exhaustion, with apparent corresponding changes in "lactacidogen" Protracted interrupted stimulation, even if not resulting in fatigue, causes increase of the phosphorus and decrease in "lactacidogen."

Howard C Day presented experimental evidences that show both for structure and behavior distinctly close similarities in the contractile vacuole in *Amoeba, Spirostomum* and *Paramoecium*

Laura Garnjobst briefly described a new marine *Euplotes* and her method for inducing at will both the encystment and excystment of this species

From results of recent experiments by methods of microdissection on early developmental phases in the eggs of the starfish *Patrica miniata,* D. M. Whitaker concluded that the "antipolar" yolk or some substance with it is essential for normal invagination and that in grafted halves following a cut through the polar axis the haploid half tends to invaginate sooner than the diploid half

P. L. Radir reported evidence from experiments on a new marine amoeba, for a monaxial polarity which persists not only throughout the activity of the normal amoeba but also in its reorganization following the excision of either its anterior or its posterior end.

In his paper on "The Fundamentalists and the Origin of Species," Dr Barton Warren Evermann expressed regret that any biologists felt it necessary for science to be represented at the Scopes trial at Dayton, Tennessee, where the only question before the court was whether John T. Scopes had violated a state law The question of the origin of species was not before the court

But why should our people believe in the evolutionary origin of species when they have had no opportunity in our schools to make any study of species of animals and plants, the only way by which any one can get any clear conception of what a species is or how species originate? A recent survey of the curricula of the 302 high schools in California showed that only a negligible percentage of the 126,000 pupils enrolled were afforded any chance whatever to study species of animals or plants Systematic zoology and systematic botany as school subjects are no longer thought worth while, so our children go through the schools without ever getting any experience in the study of species and therefore leave the schools ignorant of the facts and principles of the evolutionary origin of species

In his studies on "Luminescence of a Cirratulid Worm," Professor A R Moore found that luminescence of the cirri may yield light of brightness equal to 6 millilamberts. Exposure to clear sunlight for half an hour scarcely affects the luminescence of the live worm, but the luminescent material obtained by crushing the worm on filter-paper is destroyed by sunlight in about thirty seconds, and by exposure for nine minutes to a 6,000 candle meter light Failure of light to inhibit luminescence in the living worm is presumably due to the rapid synthesis of the luminescent material.

Francis G Gilchrist reported the results of experiments in which he subjected amphibian (*Triturus torosus*) eggs in their cleavage stages to a horizontal temperature gradient The primary polarity of the eggs and the fundamental bilaterality were not certainly affected, but the subsequent development of the dorsal axial structure was markedly influenced.

In her paper on "The Flora of Guadalupe Island, Past and Present," Miss Alice Eastwood said that on account of the great number of endemic species that have been found on the island, the flora is peculiarly interesting and is rapidly being destroyed by the goats that were introduced many years ago to furnish fresh meat to mariners in danger of scurvy and which have increased without the restrictions of natural enemies In looking over the small collection made on the island by H L Mason on the Expedition of the California Academy of Sciences to the Revillagigedo Islands in 1925, it seemed desirable to bring together the scattered records of the various collections made on the island, showing the gradual extermination of species, the introduction of some, generally weeds, and the relationship of the flora to that of the mainland

Dr. Walter Carter reported experiments in spraying sugar beets with various light-absorbing pigments to determine influence of illumination on susceptibility to curly-top disease and on partial resistance to it. Interception of heat-producing rays proved beneficial.

Dr. W. S Cooper's studies of the dune area northeast of Monterey, which were greatly aided by airplane photographs, correlated the older extensive dunes with a period of uplift and the younger dunes near the present shore with more recent subsidence. He pointed out how ecology may contribute to geology. Available moisture in a California locality for 1923–24 was less than one fifth of that for 1926–27, as shown by Dr A. G. Vestal Soil-texture data confirmed his observation that soils of chaparral habitats are generally coarser than those of grasslands.

In his paper on "Some Experiments in changing Young Salmon from Fresh to Salt Water," Alvin Seale said that during the past year the experiments had been conducted at Steinhart Aquarium with the

young of the Chinook salmon, *Oncorhynchus tschawytscha* The fishes were taken from the hatchery, their age and size were recorded, the conditions under which the experiments were conducted were under perfect control, all sudden changes of temperature were avoided, and specific gravity and temperature readings were taken each morning

Professor G J Peirce reported further studies on crystallizations in brines taken from the Bay of San Francisco As observed under high magnification, particles of foreign matter come to be incorporated into the growing crystal If unicellular algae are thus entrapped, they will demonstrate the pressure developed in the growing crystal, for their pear-shaped cells will be pressed into slender spindles These spindles do not resume their original shape when the crystal containing them is dissolved, which indicates that a very considerable force attended their compression On the other hand, grains of starch, droplets of oil and other bodies of relatively simple chemical compound are not deformed, showing that their mechanical strength is greater than that of protoplasm, which is composed of several or many compounds

The "Distribution of Nudibranchiate Mollusca" was discussed by Professor F M MacFarland, whose extensive studies on this problem are conclusive in showing that the more uniform conditions of Arctic seas permit the wide distribution of a single or small number of species of each genus, which, extending southward, has become split up into an increasingly larger number of species in response to the diversified environmental conditions met with More temperate and tropical waters contain forms whose affinities indicate utilization of former marine connections across Central America and between the Mediterranean and the Indo-Pacific seas

Following are the officers of the Pacific Division American Association for the Advancement of Science for 1927–1928, elected at the Reno meeting

President C A. Kofoid, professor of zoology, University of California.

Vice president Ernest G Martin, professor of physiology, Stanford University

Secretary-Treasurer A G Vestal, Stanford University, California (to take effect October 1, 1927)

Executive Committee of the Pacific Division

Ernest G Martin, *chairman*, professor of physiology, Stanford University, California

C A. Kofoid, professor of zoology, University of California, Berkeley

Walter S Adams, director, Mount Wilson Observatory, Pasadena (1928).

Bernard Benfield, consulting engineer, Kohl Building, San Francisco (1929).

Joel H Hildebrand, professor of chemistry, University of California, Berkeley (1929).

Leonard B Loeb, associate professor of physics, University of California, Berkeley (1931)

Emmet Rixford, professor of surgery, Stanford University, 1795 California Street, San Francisco (1928)

J O Snyder, professor of zoology, Stanford University (1930)

O F Stafford, professor of chemistry, University of Oregon, Eugene (1930)

W W Sargeant,
Secretary.

SCIENTIFIC EVENTS

THE MEDICAL SCHOOLS OF THE UNITED STATES

The Secretary of the Council on Medical Education and Hospitals of the American Medical Association, Dr N P Colwell, in a statement made public on July 11 by the Bureau of Education, Department of the Interior, reports that during the past two years changes made in medical schools in the United States have been chiefly in the erection of new buildings, improvement of teaching staffs, the rearrangement of subjects in the curriculum, and closer affiliations with hospitals, with increased opportunities for students personally to study diseases at the bedside in dispensaries and hospitals

The number of medical schools fluctuated from 80 in 1923 to 79 in 1924, when the General Medical College of Chicago was discontinued, and back to 80 in 1925, when the University of Rochester School of Medicine and Dentistry was added In 1926 the charter of the Kansas City College of Medicine and Surgery was revoked, but a new institution was promptly chartered to take its place under the name of the American Medical University of Kansas City

During the past two years the number of medical students has continued to increase Instead of only 12,930 in 1919, the number increased to 17,728 in 1924, to 18,200 in 1925, to 18,840 in 1926, and to 19,532 (estimate) in the session of 1926–27

The number of graduates also increased from 2,529 in 1922 to 3,562 in 1924 and to 3,974 in 1925, but decreased to 3,962 in 1926 Although the number of medical schools has remained at about 80 since 1920, the numbers of both students and graduates have increased.

At the beginning of the reorganization of medical schools in 1906 the 162 medical schools then existing enrolled 25,204 students, an average of 156, and turned out 5,364 graduates, an average of 33 Last year (1926), however, the 79 medical colleges in the United States enrolled 18,840 students, an average

of 238, and turned out 3,962 graduates, an average of 50. During the past few years, indeed, the medical schools rated in Class A have been filled almost to capacity.

The movement toward the building of larger teaching plants, including both medical schools and hospitals, continues During 1925 and 1926 such enlarged plants have been established and partially completed at the Universities of Colorado, Columbia, Illinois, Ohio, Rochester (N Y), Vanderbilt, Western Reserve, Wisconsin, and Meharry Medical College Those which are nearing completion or are partly occupied are of the Universities of Chicago, Northwestern, Tennessee, and the Detroit Medical College. Medical centers with more modern buildings erected nearer to teaching hospitals are being established by the medical schools of George Washington, Georgetown, and Howard Universities at Washington, D C., and also by Temple University at Philadelphia.

Since 1912 most of the medical schools have limited their enrolments to the numbers which could be given a satisfactory training in medicine, depending on their varying space, equipment and hospital relations This limitation of enrolments has reduced the attendance in few of the colleges formerly having unduly large enrolments. The capacity of all others remains the same or shows an increase

The United States still has more physicians in proportion to its population than any other country In 1925 there was one physician to every 753 people, while Great Britain reports (1921) one physician to every 1,087, Switzerland and Japan reported (1925) one, respectively, to every 1,290 and 1,359; Germany (1912) one to every 1,940, Austria (1912) one to every 2,120, Sweden (1925) one to every 3,500.

In the United States, as in other countries, there has been a tendency during recent years for physicians to locate in cities rather than in rural districts There is not, however, a shortage of physicians, the problem being one of distribution

SURVEY LINES OF THE U. S. COAST AND GEODETIC SURVEY

THE records of the Coast and Geodetic Survey show that the distance between its two surveying stations on Mt Shasta and Mt. Helena, both in California, is 192 miles This line was used in a survey extended along the 39th parallel to join the surveys and charts of the Atlantic with those of the Pacific coasts of the United States. The system of triangulation involved the measurement of a few lines across country with extreme accuracy by means of metal tapes or base bars. Each of these lines form the side of a triangle, the other sides are computed from this measured line by means of the angles of the triangles observed with high grade theodolites.

The line between Mt Shasta and Mt Helena could be used by reason of the employment of very large mirrors in the form of heliographs mounted on each of the stations. By means of the telescope of a theodolite the observer at one station could see, through his instrument, the reflected sunlight as a very dim star on the other peak

Another long line in the survey across the country by the United States Coast and Geodetic Survey was between Mt Ellen, Utah, and Uncompahgre Peak, Colorado, the distance being 182.7 miles There are many lines in the surveys of the Coast and Geodetic Survey which are more than 100 miles in length between stations.

It has been found, in recent years, to be more efficient to use electric signal lamps in the place of heliographs An ordinary auto headlight with an especially constructed bulb, with contracted filament, has been so effective as to enable the observer to see its light with the unaided eye for distances as great as 150 miles. The electric current used is supplied by ordinary dry cells, such as is used to ring door bells. It was only when the atmosphere was as clear as crystal that the visibility was so perfect Ordinarily the atmosphere has some haze in it and then the lights do not appear so bright

The distance that one can see from one part of the earth to another depends on the heights of the mountain peaks and the configuration of the intervening ground. The curvature of the earth is so great that at a very few miles it would be impossible for a man standing at the shore-line of a bay to see a man standing at the shore-line on the opposite side. Where there are deep broad valleys between mountain ranges, the greatest distances can be observed.

EXPLORATIONS IN BRITISH COLUMBIA

ROLLIN T CHAMBERLIN, professor of geology at the University of Chicago, who with Mr. Allen Carpe, of New York, was the first to climb any of the major peaks of the Cariboo range of British Columbia in 1924, has returned to the university after reaching the summits of three new peaks of th erange. Mr. Carpe, a prominent member of the American Alpine Club and one of the famous Mt Logan expedition in 1925, again was Professor Chamberlin's companion this summer.

The new peaks climbed this summer were Kiwa, with an elevation of 11,400 feet; Mt. Welcome, with an elevation of 11,150 feet, and Mt. Goodell, 10,450 feet high. Kiwa was named for a creek which has its origin in the range, and Goodell was named for "Slim"

Goodell, a packer and trapper of the region, who was a member of the expedition.

To reach the new peaks, Professor Chamberlin and Mr. Carpe back-packed their equipment up grizzly and caribou trails sixteen miles to the end of the Kiwa Glacier After they had established a camp at an elevation of 4,700 feet, they had considerable difficulty in surmounting two crevassed ice-falls Several days were required to find a route over which they could pack sleeping-bags and food to a bivouac above the second ice-fall. From this base they climbed Kiwa Peak in five hours, in an interval between heavy snowstorms

Part of the climbing on Kiwa Peak was done on a snow slope with an angle of 47 degrees, up which every step had to be cut. A part of the descent of Mt Goodell could be accomplished only by digging out steps, and the two explorers were in imminent danger of snowslides They spent seventeen days in the mountains, storms and cloudy weather often interfering with their work

Until the 1924 expedition of Professor Chamberlin and Mr Carpe, little was known of the range, the locations on the maps differing greatly Exploratory efforts made by the late Professor E W D Holway, botanist of the University of Minnesota, and Dr A J Gilmour, of New York, in 1916, were rendered unsuccessful by weather conditions Professor Chamberlin's successful trip in 1924 definitely located the range, which is separated from the Rockies on the east by that part of the Rocky Mountain Trench occupied by the Fraser and McLennan Rivers

During his exploration of the peaks this summer, Professor Chamberlin gathered data concerning glacial movements which are said to be of considerable interest to geologists.

THE USE OF HUDSON'S STRAITS FOR NAVIGATION

An important expedition, according to the daily press, has been sent out by the Canadian government, which left Halifax recently for Hudson's Straits The purpose of this expedition is to investigate the practicability of the use of the Hudson's Straits for navigation for commercial purposes

Various interests in western Canada that are behind the construction of the Hudson's Bay Railway, the establishment of grain shipping ports on the shores of Hudson's Bay, and a direct sea route to Europe, demanded that such an expedition be sent out to ascertain whether navigation of the Straits can be maintained throughout the year. The expedition is well fitted out to determine over a period of sixteen months exactly what the conditions within the straits are; whether they are closed by ice to such an extent that they will not be practicable for the world's commerce, or whether they are open and can be made a commercial avenue with proper navigation aids, such as lights, buoys, wireless stations, lighthouses and air stations

The expedition is under the command of Major M B. McLean, formerly assistant superintending engineer of the St. Lawrence Ship Channel. The personnel numbers about fifty, including three squadrons of the Royal Canadian Air Force, and also full equipment for three wireless stations. These stations are expected to keep the expedition in hourly touch with Ottawa during the whole time the expedition is employed at their work.

The expedition is also provided with a moving picture photographer, under contract with the Federal government, with instructions to film the entire expedition from start to finish. The biological board also sends a representative to make comprehensive study of fisheries.

The expedition sailed in two ships, the Canadian government ship *Stanley*, an ice-breaker, thoroughly reconditioned for her work, and the freighter *Larch*, which carries a cargo of equipment and apparatus which is said to have cost over $1,000,000 Three base stations will be established, one near Port Burwell at the eastern entrance of the Straits, another at Nottingham Island at the western entrance of the Straits, and another halfway between, which will be situated on the north shore of the Straits

Each station will consist of seven buildings—two dwellings, two hangars, one power-house and two storehouses There will be two Fokker one-engine airplanes at each station, and the *Stanley* carries a small plane, a *Moth*, for scouting work to locate the sites for the stations. These buildings were all constructed in Halifax and placed aboard the ships ready to be erected as soon as the expedition arrives at its various bases. The supplies which accompany the expedition include 450 tons of coal and 100 tons of food supplies.

LECTURES ON SCIENCE

The program of public lectures for 1927–1928 given by the Rochester Section of the American Chemical Society follows

October 3—*Some separations, old and new, by the ionic migration method*. Dr. J. Kendall, New York University, New York.

October 17—Subject of lecture not announced: Dr. C. Noller, Eastman Kodak Company, Rochester.

November 7—*Medicinals and pharmaceuticals:* Dr. A. S Burdick, Abbott Laboratories, Chicago

November 21—Mr. E. G Miner, Pfaudler Company, Rochester.

December 5—*Fuels:* DR. S. W. PARR, University of Illinois, Urbana.

December 19—*Vitamins and ultra-violet light.* DR. ETHEL LUCE, University of Rochester Medical School

January 9—*Smoke* DR G. T. MOORE, Missouri Botanical Gardens, St Louis

January 23—DR. K. C D HICKMAN, Eastman Kodak Company.

February 6—*Band spectra and molecular structure.* DR. SAUL DUSHMAN, General Electric Company

February 20—*The discovery of the ovum* DR. G. W CORNER, University of Rochester Medical School

March 5—*Pharmacology:* DR. A D HIRSCHFELDER, University of Minnesota, Minneapolis.

March 19—DR S E SHEPPARD, Eastman Kodak Company, Rochester

April 2—DR O MAASS, McGill University, Montreal, Canada.

April 16—*Wood distillation* MR. I. N HULTMAN, Eastman Kodak Company, Rochester

May 7—Some speaker on *Anti-knock fuels*

May 21—*Electro-metric measurements.* DR H C PARKER, Leeds & Northrup, Philadelphia.

Lectures at the New York Botanical Garden, during September and October, are given on Saturday afternoons at 4 00 o'clock The program follows.

The big trees of California DR. H A. GLEASON

Rarer wild flowers of New York City and vicinity MRS. N. L BRITTON

Some successional aspects of the local vegetation PROFESSOR GEORGE E NICHOLS.

The Westchester County Park System MR. JAY DOWNER.

Dahlias (exhibit of living collection) DR. MARSHALL A HOWE

In Southern California. MR. HOWARD H CLEAVES

Autumn coloration DR A. B. STOUT.

The campaign against diseases of our food plants. MR F. C. MEIER.

The flora of the Catskill Mountains PROFESSOR OLIVER P MEDSGER.

SCIENTIFIC NOTES AND NEWS

THE regular fall meeting of the executive committee of the American Association for the Advancement of Science will be held on Sunday, October 16. Matters to be considered by the committee should be in the hands of the permanent secretary in Washington a few days before the meeting.

PROFESSOR E W BROWN, of Yale University, has accepted the invitation of the American Mathematical Society to give the fifth Josiah Willard Gibbs lecture in connection with the meetings of the society and of the American Association for the Advancement of Science at Nashville, Tennessee, in December, 1927.

DR. ROBERT A MILLIKAN, director of the Norman Bridge Laboratories of the California Institute of Technology, will give a course of six Lowell lectures in Boston beginning on April 13, 1928 His subject will be "Twentieth Century Discoveries in Physics"

A COURSE on "Recent Progress in Medicine and Surgery" will be given during the autumn at the New School for Social Research, New York City The opening lecture will be by Dr Simon Flexner, director of the Rockefeller Institute for Medical Research; other lectures will be by Drs. Walter B Cannon, professor of physiology, Harvard Medical School, Boston, Dr Lewellys Barker, emeritus professor of medicine, the Johns Hopkins University Medical School, Baltimore, Dr Francis Carter Wood, Columbia University College of Physicians and Surgeons, Dr Charles V Chapin, Providence, president of the American Public Health Association, and Dr Louis I Dublin, of the Metropolitan Life Insurance Company The lectures are intended for laymen, most of whom will be college graduates and some of them physicians and nurses

WE learn from *Nature* that Professor Edward Westermarck has accepted an invitation to deliver the Frazer Lecture at Glasgow in 1928 It will be remembered that the lectureship is vested in four universities in Great Britain in rotation and this time the election falls to Glasgow In view of the fact that the British Association will be meeting in Glasgow in 1928, the date of the lecture will be arranged to coincide with the date of the meeting

DR HOWARD T. KARSNER, professor of pathology in the school of medicine of Western Reserve University, has been appointed chairman of the division of the medical sciences of the National Research Council, Washington, D. C, for one year from September 16

DR. PAUL EHRENFEST, professor of theoretical physics in the University of Leiden, has been elected a corresponding member of the Academy of Sciences at Göttingen

M LOUIS RAVAZ, director of the National School of Agriculture at Montpellier, has been elected a correspondent in the section of rural economics of the Paris Academy of Sciences, to succeed the late M. A. Balland.

DR. REINHARD BRAUNS, professor of mineralogy and petrography in the University of Bonn, has been elected a foreign member of the Norwegian Academy of Sciences at Oslo.

THE Russian Academy of Sciences at Leningrad has elected to membership Dr. Heinrich Zeiss, professor of tropical medicine at Moscow.

DR. HIDEYO NOGUCHI, of the Rockefeller Institute for Medical Research, was elected an honorary member of the "Société Dermatologique et Vénéréologique d'Odessa" at its meeting of May 15, when the twenty-fifth anniversary of the founding of the society was celebrated.

AT the celebration of the five hundredth anniversary of the founding of the University of Louvain, the honorary degree of doctor of medicine was conferred upon Dr. James B Murphy, of the Rockefeller Institute for Medical Research

DR ARTHUR D BUSH, Decatur professor of pharmacology, Emory University School of Medicine, Atlanta, since 1923, will retire at the beginning of the autumn term on account of ill health His successor has not yet been appointed

DR HAROLD E. JONES, assistant professor of psychology at Columbia University, has been appointed director of research at the newly-created Institute of Child Welfare, of the University of California.

THE vacancy in the position of medical officer of the drug-control laboratory of the food, drug and insecticide administration, caused by the resignation of Dr J. S Jamieson, has been filled by the appointment of Dr Paul McC. Lowell

F A ERNST, acting chief of the Fertilizer and Nitrogen Fixation Investigations and for some time a member of the Fixed Nitrogen Research Laboratory staff, has resigned to join the engineering staff of the Atmospheric Nitrogen Corporation, at Syracuse, N Y

WE learn from *Nature* that Mr. Geoffrey Evans has been appointed principal of the Imperial College of Tropical Agriculture at Trinidad. Mr Evans was in the Indian Agricultural Service from 1906 until 1926 He was for a time attached to the Queensland Government in Australia as director of cotton culture, and during this period he also worked in Fiji, Papua and New Guinea.

PROFESSOR L BOEZ, of the hygienic institute of the University of Strasbourg, has been appointed director of the Pasteur Institute at Saigon, French Indo-China.

PROFESSOR LEON W. COLLET, of the University of Geneva, will be visiting lecturer on geology at Harvard University during the first half of the school year beginning on September 26. Professor Collet will offer a course on the "Geology of the Alps," as well as a series of lectures on "The Principles of Geology."

DR. WILLIAM F. DURAND, past-president of the American Society of Mechanical Engineers, sailed on August 16 as the official United States delegate on the International Advisory Committee on Prime Movers of the International Electrotechnical Commission. The meetings were held at Bellagio, on Lake Como, Italy, September 4 to 24. Dr Durand also served as acting delegate on the Rating of Rivers in the place of N. C. Grover, of the Department of the Interior, the official delegate, who was unable to attend the sessions.

DR. E. HORNE CRAIGIE, who since the beginning of the year has been working in the laboratories of the Instituto Cajal in Madrid and of the Central Institute for Brain Research in Amsterdam, is in Budapest for the tenth International Congress of Zoology At the close of the congress Dr Craigie will return to Toronto

BROTHER LEÓN, professor in the Collège of La Salle, Havana, who came to New York to receive the honorary degree of doctor of science from Columbia University at the commencement exercises in June, spent parts of June and July at the New York Botanical Garden, in continuation of studies of the Cuban flora, which, in cooperation with members of the garden staff, have extended over more than fifteen years

DR. EUGENE ALLEN SMITH, emeritus professor of mineralogy and geology in the University of Alabama and state geologist since 1873, died on September 7, aged eighty-six years

DR WILLIAM LIBBEY, professor of physical geography at Princeton University from 1883 to 1923, died on September 6, aged seventy-two years

JUERGEN HERMAN PAARMANN, curator of the Davenport, Iowa, Public Museum since 1902, died recently Mr Paarmann was born in Davenport in 1870 and was graduated from the State University of Iowa in 1901

DR CHARLES C GODFREY, president of the American Association of Variable Star Observers, conducted in cooperation with the Harvard Observatory, died at Bridgeport, Connecticut, on August 31, aged seventy-one years

RAY P. TEELE, chairman of the special advisory committee appointed by the Secretary of the Interior to investigate economic conditions of Indian irrigation projects in the West, died while investigating the Uintah irrigation project at Myton, Utah, on September 1 at the age of fifty-nine years

DR. VICTOR G KIMBALL, assistant professor in the veterinary school of the University of Pennsylvania, died on September 9.

THE twelfth annual meeting of the Optical Society

of America will be held at Union College, Schenectady, N. Y, October 20, 21 and 22. Headquarters will be at the Van Curler Hotel

THE United States Civil Service Commission states that there is a vacancy in the position of senior aeronautical engineer at the Langley Memorial Aeronautical Laboratory, Langley Field, Va, at a salary of $5,000 a year, and that in view of the importance of the position in the field of aeronautical research, and in order to secure the appointment of a thoroughly qualified man for the work, an unusual method of competition will be followed to fill the vacancy Instead of the usual form of civil service examination, the qualifications of candidates will be passed upon by a special board of examiners, composed of Dr G W Lewis, director of aeronautical research, National Advisory Committee for Aeronautics, Dr F C. Brown, acting director of the Museums of the Peaceful Arts, Mr Starr Truscott, aeronautical engineer, National Advisory Committee, and Messrs A S Ernest and A W. Volkmer, examiners of the Civil Service Commission For the purpose of this examination the persons named will be examiners of the Civil Service Commission. Applications should be received not later than October 4

APPLICATIONS for pharmacologist in the Hygienic Laboratory, Public Health Service, Washington, D C, and vacancies occurring in positions requiring similar qualifications, must be on file with the Civil Service Commission at Washington, D C, not later than October 11 The entrance salary is $3,600 a year. The work will be to carry on pharmacological and toxicological investigations and research. Competitors will not be required to report for examination at any place, but will be rated on their education, training, experience and fitness, and publications or thesis to be filed with the application.

A MOTION picture machine which will take 48,000 exposures a second and which will be useful in scientific and experimental work has been invented and patented in Germany. There are certain very fast operations beyond the human eye and ordinary film photography, where a scientific investigation at such high speeds has created an actual need for high-speed photography Among these operations may be mentioned the investigation of electric discharges, electrical switching apparatus, the determination of the speed of bullets, the operation of high-speed looms and sewing machines, investigations of mental working machinery and oscillations and vibrations on almost every kind of machine, etc.

Erratum.—In the review of Eddington's book on "The Internal Constitution of the Stars," by Dr H. H. Plaskett, printed in the issue of SCIENCE for July 22, several lines were misplaced at the bottom of the right-hand column on page 82. The passage should read:

Of the several quantitative predictions furnished by Eddington's model, none is more striking or more general than this relation that the luminosity of a star, apart from a small factor depending upon the surface temperature, is a single-valued function of its mass The relation contains but one disposable constant (the proportionality constant of Kramers's absorption law), and this is fixed from the mass, luminosity and effective temperature of a single star (Capella) It is then found that all thirty seven stars of known mass and luminosity, both giants and dwarfs, lie on Eddington's mass-luminosity curve with the average residual of the order of half a magnitude

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UNIVERSITY AND EDUCATIONAL NOTES

KEUKA COLLEGE, at Penn Yan, N Y, has received a gift of $150,000 from Ball Brothers, glass manufacturers, of Muncie, Ind. This makes a total sum of $250,000 which they have given to the college.

A CHAMBER OF COMMERCE committee in Cambridge, Mass, has reported that Cambridge property is $30,000,000 underassessed, chiefly because of the big holdings of its colleges A conference is recommended with officials of Harvard University and the Massachusetts Institute of Technology to see what steps might be taken to halt the continuous acquisition of property by these institutions It is asserted that as holdings were diverted to educational uses, they automatically came off the tax list, forcing up the tax rate and discouraging new developments

PROFESSOR A F KUHLMAN, who has been on leave of absence during the second semester of the present academic year, working for the Social Science Research Council, resumes his work in the University of Missouri at the beginning of the academic year and will act as chairman of the department during the absence of Professor Ellwood

DR. HARRY F WILKINSON has been appointed assistant professor in the department of surgery, in charge of work in otolaryngology at the medical school of the University of Chicago Dr. Wilkinson has been a fellow in otolaryngology at the Mayo Clinic for about three years.

DR. RICHARD H MEADE, of Richmond, Virginia, has been appointed assistant professor of surgery in the University of Virginia.

M ROUCIERE has been appointed professor of anatomy at the University of Paris, to succeed M. Nicolas; M. Loeper, professor of therapeutics, to succeed M.

Carnot; M. Tailly, professor of physics, to succeed M. Daniel Berthelot, and M. Guérin, professor of botany, to succeed M Guignard

DR EDWARD LUKAS, of the University of Graz, has been called to a professorship of folklore in the University of Tubingen

DISCUSSION AND CORRESPONDENCE

PHILOSOPHY AND THE SCIENCES

NOTHING is more to be desired in the world of scholarship to-day than a sympathetic understanding between philosophers and scientists Different as are their problems and their points of view, their tasks are vitally interrelated, and it is in the hope of promoting in some degree at least the necessary rapprochement that these lines are written

The aim of every scientist, as I should conceive it, is to understand as intimately and in as great detail as possible some limited portion of our vast universe. the aim of the philosopher, on the other hand, is, not to fill out the gaps in scientific knowledge as it stands to-day, but to understand the facts that the particular sciences *have* revealed in their relation to all that is, to see things in the light of the whole Being finite, no human thinker would dare pretend that this "synoptic view" can ever be more than the merest glimpse, but it is his hope that some such glimpse may be attained, nevertheless, however distorted in time and space that glimpse may be

The astronomer, the physicist and the chemist, in their various ways, are interested in the composition of matter, the laws of energy and the structure of the material universe, the biologist seeks to understand the structure and activities of organisms, the conditions which make life possible and the laws of its evolution, the psychologist, when he remains within his proper field, examines in a precisely analogous fashion into the phenomena of the human (and animal) mind, with a view to analyzing and classifying these and formulating the laws of their succession and correlation In cultivating their respective fields, the physical scientist definitely excludes vital phenomena and the whole realm of animal or human mentality from consideration; the biologist ignores the laws of non-living matter and, together with the physicist, disregards the influence of consciousness, and the psychologist concerns himself with those matters which both groups of his fellow-workers purposely and properly neglect. Moreover, in each of these domains the scientific investigator restricts himself to the question of how matter, life and mind, respectively, work—he does not inquire into their inherent nature, and still less into their relationships as parts of one great Reality. But what *is* matter? What *is* life? What *is* mind? What is the place of mind in physical nature? How are the truths of the various sciences to be unified into a great world-view? These are all questions over and above the specific programs of any one science they are *meta*-physical, *meta*-biological, and *meta*-psychological questions. As for God, "I have no interest in that hypothesis," says science—and quite properly so, but if the follower of science is a man as well as a scientist he has an *ineradicable* interest in God which only philosophy can *intellectually* (I do not say emotionally or practically) satisfy And the great and to many persons absorbing question of the correlation of religion and science is also a distinctively philosophical problem

Again, philosophy and the sciences seem to differ fundamentally in their *attitudes* toward the world. The attitude of the scientist is a detached, disinterested, impersonal one he wishes to know what are the facts about the world, quite regardless of their positive or negative value to himself or to other men; and he sets forth as his ideal the explanation, or at least correlation, of these facts in terms of the all-comprehending principle of causality, and in exclusion of any question of ends or purposes. But the philosopher is supremely interested in those very things which the scientist for his own purposes intentionally ignores his paramount concern is that very "realm of ends" or of values which is quite properly taboo to the scientist. From this standpoint, the contention of many present-day scholars that ethics should be treated as an inductive science, "the natural history of goodness," is a complete perversion of the true place of moral philosophy in the general scheme of things. That there is a place for "ethology," the science of character as Mill proposed it, and for the "history of moral ideas" in Westermarck's phrase, there can be no doubt; but the former of these is a branch of psychology, and the latter a division of history, and both of them are scientific and so non-philosophical disciplines The subject-matter of ethics as moral philosophy is the nature of the good as the supreme end of conduct, for as that of philosophical logic is truth, and of esthetics beauty—the value and validity of moral ideas, not merely their existence or even their evolutionary development

When we consider religion, which is so closely interrelated with science, on the one hand, and philosophy, on the other, a quite different situation confronts us. Ethics is, indeed, a system of ideas, and so conceivably amenable to scientific treatment; and perhaps the same might even be said of theology, regarded as a theory of God and our relation to Him But religion is not a system of ideas, religion is not

theology, religion is not a theory about life or about God or about our relation to Him: religion is life, it is our relation to God. Philosophy, as has been said, may intellectually satisfy man's yearnings for the infinite, and may attempt to set forth the relation between the truths of science and the truths underlying religion, but let us avoid confusing these purely intellectual endeavors with the living practical reality!

Finally, careful reflection over what has gone before should, it would seem, inevitably impel the reader to the conclusion which led in the first place to the writing of what has been here written, namely, that philosophy and the sciences, far from being enemies, rivals or even strangers, are inextricably interdependent To science the philosopher must go for the facts he wishes to correlate, interpret and evaluate. no longer can one hope to obtain the data for philosophical investigation from the depths of his own inner consciousness, but at every step the philosopher is dependent on what science has accomplished through the use of its own empirical and analytical methods. Metaphysics is dependent on the work of the physicist, the biologist and the psychologist, esthetics, ethics and the philosophy of religion *are* dependent on the investigations of the psychologist and the historian, and so with the other philosophical disciplines But there is another side to the picture also, for if the scientist contributes the materials for the philosopher to work upon, equally true is it that the philosopher has something to contribute to the scientist which may be to him in his wider-reaching human nature of equal value, namely, breadth of interest and the synoptic spirit Each science in itself has a narrow range of interest, but under the influence of the great philosophical ideal of the unity of all knowledge and of all truth the work of the scientific investigator may be broadened, deepened and illumined to a degree which will carry him far beyond the confines of any one field, however penetrating his work in that field may be

JARED SPARKS MOORE

THE JACOBS CAVERN MASTODON AGAIN

IN SCIENCE for October 14, 1921, Mr J L B. Taylor, of Pineville, Mo, announced his discovery, in the well-known Jacobs Cavern located on his farm, of certain perforated and engraved bones All but one of the eight or nine specimens recovered subsequently disintegrated and this surviving bone carried the incised figure of what appeared to be a mastodon The discovery was of extreme interest and so, although Jacobs Cavern was excavated in 1903 by Professors Peabody and Moorehead, the American Museum ultimately undertook a reexamination. This was done in part by myself with results that did not warrant extended excavation. I also gave the engraved bone a prolonged examination, and on December 28, 1923, in open meeting of the American Association for the Advancement of Science, declared it as in my opinion a plain fraud

Last year there was published as Part 6 of Volume 19 of the Anthrop Papers of the American Museum of Natural History a brief paper entitled "The Antiquity of the Deposits in Jacobs Cavern" The author is Dr. V C Allison, Bureau of Mines, Pittsburgh, and his paper purports to be chronologic determinations based on the study of a stalagmite taken from Jacobs Cavern. Such studies are of interest to archeology, but until examined by one or more competent geologists the precise conclusions of this paper can hardly be accepted Furthermore this paper gives the unfortunate impression of being, incidentally at least, an effort to rehabilitate the abovementioned mastodon engraving.

Space prohibits extended consideration of the subject here, but I must submit the substance of my own findings with respect to this engraved bone. They are as follows (1) The said carved bones were admittedly found in a heap of loose dirt on the cave floor and their relation to the remaining deposits is therefore indeterminable (2) It is difficult to understand why seven out of eight bones—unless tampered with—should have completely disintegrated, when the surviving specimen is in a fair state of preservation, as are also 3,000 or more bone fragments collected in the cave in 1923. (3) The cave fauna reveals no extinct species. (4) Archeologists are not familiar with bones and shells perforated after the manner of those under discussion (see illust. p. 593, Natural History, Vol. 21) (5) The perforation of the surviving bone is fresh-looking and shows no evidence of the piece having been suspended for any length of time by a cord. (6) The specimen as a whole shows little, if any, of that wear and polish commonly found on used artifacts. (7) Archeologists are not familiar with the indicated style of art on bone in America. (8) The engravings on the specimen give the appearance of having been fitted into the well-preserved surfaces of the bone. (9) In the case of the mastodon engraving the color of the artificial incision surfaces is quite different from that of the natural bone surface (10) All incisions show such fresh surfaces and sharp angles as could hardly have been preserved on an ancient specimen. (11) The incised lines are of such depth, regularity and precision as to preclude their having been executed with flint tools.

These and other objections were duly communicated to both the writer and the editor of the paper, and if they had been cited in full I should not now refer to the subject.

N. C. Nelson

American Museum of Natural History

THE SEX RATIO OF ADULT TRICHINAE

Throughout the literature vague and contradictory statements prevail concerning the intestinal phases of the life-history of *Trichinella spiralis*. These relate especially to the sex ratio, and to data relative to the abundance and duration of the adult worms in the intestine of the host. They are due largely to the tedious and imperfect methods which have been employed for collecting the intestinal stages.

While engaged in experimental work on this parasite the writer evolved a simple and effective method of obtaining the adults in large numbers. This consists of stripping the contents of the intestine of the infected animal into a physiological salt solution and screening the adults from the débris with a small-mesh wire screen. By using this method it has been very easy to make exact observations on the intestinal worms.

White rats were fed heavy doses of trichinized flesh and beginning with the third day were killed and examined at short intervals. From one specimen, opened at the beginning of the third day, 2,176 worms were recovered; of these 1,196 were females and 980 were males At the end of the third day 73 adults, of which 36 were males, were found in the intestine. The next rat, opened at the end of four days, had 12 adults, of which 8 were females and 4 were males, which would indicate a very light infection. At the end of six days 51 males and 63 females were found. The condition was about the same at the end of eleven days, when 73 males and 81 females were taken from the intestine. Thirteen days after feeding one of the rats contained 451 adult worms, of which 324 were females. At this time there seems to be a dropping off in the numbers of both sexes, for at the end of sixteen days only 4 adults were found, one of which was a living male. One of the females was dead and found in the feces. The diaphragm was well filled with the migrating larvae, indicating a very heavy infection. Subsequent examinations made at the end of eighteen, nineteen, twenty, twenty-one and thirty-four days did not yield any adults, while in each instance the migrating larvae or the encysted larvae (encystment beginning at the twentieth day) were found to verify the infection.

These data indicate that at the outset the males and the females are equal in numbers. There is a gradual decline in the proportions of the males up to the thirteenth day, and at this point the worms of both sexes begin to leave the intestine rapidly. This continues until the sixteenth day, when very few of either sex were found. The males and the females were both found in the intestine as late as the sixteenth day, which seems to be about the normal duration of the adults in the intestine.

Reed O. Christenson

Department of Zoology, University of Minnesota

A NEW LOCALITY IN CHINA FOR LYTTONIA RICHTHOFENI KAYSER

During the years (1909–1915) that the undersigned, now of the Fifth Avenue High School, Pittsburgh, Pennsylvania, was stationed at the University of Nanking, China, as head of the department of biology and geology, he did much collecting from the Chihsia Limestone at Chihsia Shan. A representative collection of the material thus obtained was sent to the Carnegie Museum, Pittsburgh, where it has been studied. In November of 1926, Dr. Ichiro Hayasaka, head of the department of geology of the Japanese Imperial University of Formosa, visited the museum and went over this material with the undersigned. At that time it was discovered that two or three specimens of a brachiopod, tentatively identified as *Oldhamina decipiens* Waagen, were really small specimens of *Lyttonia richthofeni* Kayser.

Considerable interest attaches to this discovery because the finding of this diagnostic Permian fossil in the Chihsia limestone indicates that this limestone can no longer be classed as Dinantian, as placed by Dr A W. Grabau, of the Chinese Geological Survey of Peking, but instead must be regarded as Permian.

William Millward

Bennerdale, Pennsylvania

PHOTOMETRY

Mr. Irwin G Priest has been good enough to send me a copy of his letter to you, dated June 21, concerning the description in my recent book "Photometry," of the instrument developed by him for heterochromatic photometry (pp. 244–5)

While agreeing, of course, that his instrument is in no wise identical, either in principle or in use with Helmholtz's "Leucoscope" it still appears to me that "Leucoscope Photometer" is a not inappropriate description of the instrument which is, in essence, a photometer in which a color match is obtained by means of the rotatory dispersion of quartz, and a brightness match by means of polarization prisms. Nevertheless it is clear that as Mr. Priest is the in-

ventor of the instrument he must necessarily be entitled to object to having any name attached to it which, in his opinion, is liable to lead to misunderstanding. I can, therefore, assure him that should a further edition of my book be called for, the alteration will certainly be made. In the meantime I feel sure Mr. Priest will agree that the description of the instrument which I have given in the text of my book is in no way misleading.

JOHN W. T. WALSH

QUOTATIONS

RESEARCH IN MEDICAL PRACTICE

RATHER more than a year ago the Ministry of Health submitted to the British Medical Association a scheme for cooperative research by panel doctors. This scheme has now been considered by the Insurance Acts Committee of the association in consultation with representatives of the Ministry of Health, and certain conclusions have been arrived at which are likely to exercise an important influence on the future of research work in general practice. Research work by general practitioners, it is felt, should not be restricted either to panel doctors or to panel patients, but should be open to all medical men who may desire to undertake it. It should be voluntary and it should be unpaid. Moreover, the subject or subjects "should be capable of being dealt with by the individual practitioner in a simple manner." This last recommendation is likely to meet with the approval of all who understand the difficulties attending any research work in general practice; it is, moreover, justified fully by the nature of the information of which the profession stands at present in need. The late Sir James Mackenzie, who was the first man in this country to recognize the necessity of continuous research work in general practice, emphasized again and again the fact that knowledge is still lacking about the most simple of human ailments. He was wont, for example, to insist that the nature of pain and the mechanism of its production are unknown, and to ask how, in these circumstances, physicians could hope to deal successfully with this commonplace symptom. His challenge still stands; but the new proposals suggest that it is about to be taken up in the spirit in which it was delivered.

The British Medical Association takes the view that the organization of the investigations to be carried out should be entrusted to itself, and proposes to make use of its machinery of divisions and branches to facilitate the work. There can be no reasonable objection to that plan provided that care is exercised to prevent research work being reduced to the level of a mere *questionnaire*. True research, as Sir Ronald Ross has so often pointed out, springs from the spirit of curiosity and the spirit of wonder and is, consequently, difficult to organize. Research workers are born, not appointed. Thus it may be hoped that there is room in the new scheme for the encouragement and assistance of individuals or groups of individuals who have, in the vast field of general practice, begun to cultivate plots of their own. Such workers have, in all periods, been the real architects of progress. They submit, as a rule impatiently, to the restrictions of "inquiries" which are addressed to them by others, but they possess always great funds of patience and of self-denial for use in their chosen labors. To discover such workers and to help them is a task of no little difficulty and delicacy, but it is a task well worth carrying out. There is room, indeed, in any liberal scheme of medical research for the individual as well as for the group or team. Information which can be obtained in the form of answers to set questions ranks by common consent lower in point of value than that kind of knowledge which inspiration and devotion are able to win.—*The London Times*.

SCIENTIFIC BOOKS

Introduction to the History of Science. Volume I, from Homer to Omar Khayyam. BY GEORGE SARTON, Associate in the History of Science, Carnegie Institution of Washington. Published for the Carnegie Institution of Washington by The Williams and Wilkins Company, Baltimore, 1927. p. i–xi, 1–839.

THIS large volume is the first of several volumes in preparation which mark the most comprehensive synthesis in the history of science thus far conceived. It registers an epoch in the writing of history. Sarton defines science as "systematized positive knowledge" and to this definition gives a broad interpretation to include not only physical science, mathematics and medicine, but also the early history of philology, for "the discovery of the logical structure of language was as much a scientific discovery as, for example, the discovery of the anatomical structure of the body," also the history of religion, for "until relatively modern times, theology was an intrinsic part of science, and not only that, but, in the opinion of most men, all other sciences were subordinated to it." The clash between Greek ideals and the oriental religions (chiefly Judaism and Christianity) is "one of the greatest intellectual conflicts of history." The author includes also parts of the history of music—"indeed the theory of music was considered a part of mathematics almost until modern times." Some attention is

paid to pseudo-science—astrology, alchemy, physiognomy, oneirology—for "it is not always easy to distinguish a pseudo-science from one which is sound but imperfect." Very little space is allowed to the work of magicians because "their purpose was but too often of a sordid nature," and quite different from the ideals of theologians and scientists. The author says: "Theologians were trying to reach the same goal as the men of science, they generalized prematurely, they were walking along the same road, but much too fast. Magicians did not follow that road at all; they were sidetracked or turned in hopeless circles." There is nothing in Sarton's study to support the doctrine that magic stimulated experimental science "Magic is essentially unprogressive and conservative; science is essentially progressive; the former goes backward; the latter, forward."

The present volume is an introduction to the history of science from Homer to Omar Khayyam. The marking of the initial and end periods by these great literary names may seem strange to one who does not remember that in Homer there are matters of interest on geography, astronomy, anatomy, medicine, surgery and metallurgy, and that Omar Khayyam was a distinguished writer on mathematics and astronomy. Early Babylonian, Egyptian and Chinese science is not given in this volume because "it is not yet possible to give a continuous account", this early science will be presented in separate chapters later when it is expected that "our knowledge of these difficult subjects will be materially improved."

The treatment is chronological From the ninth century B C. down through the eleventh century, the subject matter is presented in thirty-four periods varying in length from two centuries to half a century. The comprehensiveness of Sarton's scheme appears from his consideration in each period of the contemporaneous science of all the countries of the old world which were scientifically active at that time. The broadened viewpoint thus gained may be illustrated by the seventeenth century which Henry Hallam, with a vision confined to Europe, had called the nadir of the human mind; Sarton, in a more comprehensive view, finds the first half of that century "a golden age in at least four countries—Arabia, Tibet, China and Japan." The heading of each period after the first two bears the names of one or two outstanding scientists; thus we have "the time of Thales and Pythagoras," "the time of Hsüan Tsang," etc. It is of interest to notice that of the thirty-four names, sixteen are Greek or rather Hellenistic, five are Roman, three are Chinese, two are Byzantine, one is Persian, three are Muslim, one is Western European.

The treatment of the different periods is according to a uniform plan. First comes a survey of science in the period considered, then a presentation of the individual scientists classified by the subjects (religion, philosophy, mathematics, astronomy, geography, alchemy, medicine, historiography, law, or philology) in the cultivation of which they were respectively most conspicuous A very compressed outline of the life and work of each writer is given, followed by a bibliography which in the case of prominent men like Galen covers several pages. Sarton says: "The best way of using this work is to read the introductory chapter and the first section of succeeding chapters, and to consult the other sections only as far as may be necessary to satisfy one's curiosity or to find an answer to a definite question"

Sarton's work is written under the dominance of his conviction that the proper procedure is not to pursue first the history of some one science and then take the history of other sciences, one at the time. This tandem arrangement is repugnant to his ideals. One should study, not the history of the sciences, but the history of science Moreover, one should not confine one's attention to any one country like Greece or India, but should take a world view of scientific achievement Such a synthetic process alone will afford a full picture, free of distortion, of the intellectual progress of mankind.

The work is prepared with freedom from national bias and with painstaking care. If the great discovery of the precession of the equinoxes is attributed to the Greek Hipparchos, rather than to the earlier Babylonian astronomer Kidinnu, it is because the positive proof of Kidinnu's achievement has been published only recently, while Sarton's volume was going through the press.

The endeavor of the author, we take it, has been not to produce a book which would rank among the "best sellers," but a book which would be a real *vade mecum* to all serious students of the history of science. It ought to be in every college library. Readers having already a modicum of knowledge of the history of science, at least in one field, are the ones who will profit most by this publication. Dr. Sarton has the scientific and keen philosophic insight which are necessary for successful historical research in this field. He and many other modern lovers of systematized positive knowledge, when contemplating the achievements of science since the time of Homer in lifting man to higher intellectual endeavor, would hardly hesitate to invoke the scientific spirit in the words which Lucretius addressed to Epicuros: "Thou, father, art discoverer of things, thou furnishest us with fatherly precepts, and like as bees sip of all things in the flowery lawns, we, O glorious being, in like manner feed from out thy pages upon all the golden maxims, golden I say, most worthy ever of

endless life. . . At all this a kind of godlike delight mixed with shuddering awe comes over me to think that nature by thy power is laid thus visibly open, is thus unveiled on every side"

FLORIAN CAJORI

UNIVERSITY OF CALIFORNIA

AWARDS FOR RESEARCH AT THE UNIVERSITY OF CALIFORNIA

MANY members of the University of California faculty have received awards from the research fund of the university to carry on scientific and scholarly research next year The research fund was created by the Board of Regents in 1917–18 with an initial appropriation of $2,000 For the academic year 1927–28 the regents have appropriated $85,000 in support of specific research projects This sum is considerably supplemented by balances available on June 30, 1927, and by liberal donations from individuals and foundations Grants in support of research are made by the president with the advice of the Board of Research, a committee of the Academic Senate, to individual members of the university or to departments on the basis of the merits of their projects and estimates of the cost These grants are supplementary to provisions for research in regular departmental budgets, particularly such as those of the Lick Observatory, Scripps Institution of Oceanography, Hooper Foundation for Medical Research and the Agricultural Experiment Station

The Board of Research is composed of the following members of the faculty A O Leuschner, *chairman*, E C Hills, C A. Kofoid, G N Lewis, C. B. Lipman, K. F Meyer, F J Teggart, L. B. Loeb, *secretary*

The awards to date for research for 1927–28 are as follows

Professor E B Babcock and Professor J. L. Collins, for a taxonomic study of the genus Crepis and genetic and cytological studies of Crepis hybrids

Professor A R Davis and Professor D R Hoagland, for the study of plant growth under controlled environment.

Professor C B Lipman for two assistants in research on tree injection and on the essential chemical elements essential to plant growth.

Professor H M. Evans, three awards, supplementary to donations already made to assist in research on the relations between nutrition and fertility, on the effect of the endocrines, especially the hypophysis on the gonads and in a study of the sex cycle of the cat

Professor R O Moody, for a radiographic study of the abdominal viscera.

The Department of Anthropology, Professor R H. Lowie, *chairman*, for an assistant in research in connection with ethnological and archeological survey of California.

Professor A. L. Kroeber, for an assistant in determining the successive stages of development of the textile arts in prehistoric Peru

The Department of Bacteriology, Professor K F Meyer, *chairman*, for an assistant, for a study on hypersensitiveness with bacterial protein fractions.

Professor G L. Foster, for a study of carbohydrate metabolism of muscle

Professor D. M Greenberg, for research in electrochemistry of protein solutions.

Professor C. L A Schmidt, an award supplementary to a grant already made, for an assistant in research on the dissociation constants of amino acids

Professor E S Sundstroem, for a study of acclimatization to low pressures of temperature and effect of low oxygenation on cancerous rats

Professors T. H Goodspeed and R. E. Clausen, for genetic and cytological investigations on *Nicotiana*

The Department of Chemistry, Professor G. N Lewis, *chairman*, for chemical research by members of the staff as follows

Professor W C. Bray, for researches on the mechanism of inorganic reactions, involving the mechanism of catalytic agents in homogeneous and heterogeneous systems.

Professor W. C Blasdale, for a study of phase relations involved in sea water or marine deposits with special reference to the extraction of valuable constituents from such deposits.

Professor G. E. K. Branch, for a study of polarization in organic molecules and their effects on the rates and methods of reactions

Professor E D Eastman, for a study of high temperature equilibria of metal oxides with special reference to the reduction of the oxides of free metals, the study of the third law of thermodynamics applied to solid solutions, and the free energy of water from the study of the oxygen electrode.

Mr W F. Giauque, for a study of problems involving the third law of thermodynamics, and the production of extremely low temperatures by means of high paramagnetic substances.

Professor G E Gibson and Professor H. C Ramsperger, for a study of the absorption spectrum of iodine bromide and related substances.

Professor G E Gibson and students, for (1) isotherms of gas mixtures at high pressures with a view to determination of free energy and entropy of mixing, and (2) determination of straggling of alpha particles from radium rays in various gases by the Wilson track method.

Professor T R. Hogness, for a study of positive ray analysis with special reference to this work as a means of studying molecular reactions.

Professor J H. Hildebrand, for (1) solubility relations in terms of Raoult's law and internal pressures, and (2) problems related to phenomena of surface tension and colloidal chemistry.

Professor W. M. Latimer, for (1) studies of the distribution of thermal energy in solids at low tempera-

tures with reference to the determination of the entropy and free energy of chemical substances, (2) problems relating to the effect of ionic sizes in solution in reference to the energy and reactivity of ions, and (3) Professor Latimer and students, the electrode potential of aluminum from the entropy of aluminum ion

Professor G. N Lewis, for (1) the photon theory and the nature of light, (2) the magnetic factors involved in molecule formation, and (3) photon theory applied to the rates and mechanism of chemical reactions, and the limiting entropies at high pressures and other thermodynamic problems.

Dr A. Lachman, for (1) a study of Benzil rearrangement, and (2) auto reduction of nitric esters to ammonia and stability of petroleum oils

Professor A R. Olson, for (1) experiments on the nature of light, (2) chemical effects of X-rays, and (3) resonance and ionization potentials of atoms

Professor C W Porter, for (1) photochemical reactions with special reference to the synthesis of organic compounds, and (2) problems relating to organic molecular rearrangements.

Professor H C Ramsperger, for a study of the thermal and photochemical decomposition of azomethene and the photochemical rearrangement of chlor-acetanilid.

Professor M. Randall, for a systematic collection of activity data on electrolytes in aqueous solutions

Dr G K. Rollefson, for a study of the atomic energy levels as interpreted from soft X-ray data.

Professor T. D Stewart, for a study of the decomposition of quaternary amides and of the reactivities of ethylene and the properties of alpha cyanamides.

Professors C. Derleth and R. E Davis, for experimental work in connection with the arch dam investigation of the Engineering Foundation.

Professor John S Shell, for research in dental alloys

Mr P Byerly, for a detailed analysis of earth motion during the passage of seismic waves of various types

Professor N. E A Hinds, for a geological study of nature and metamorphic effects of granodioritic intrusives in the vicinity of Redding, California

Department of Geology, Professor George D Louderback, *chairman*, for researches in sedimentation and sedimentary petrology

Professor Franz Schneider, for copying and expressage of necessary letters in connection with the publication of a volume of Gutzkow's letters in conjunction with Professor H. H. Houben, Berlin

Professor Lucille Johnson, for a study of the colloidal nature of certain foods.

The Department of Household Science, Professor Agnes Fay Morgan, *chairman*, for the departmental research program, "occurrence and function of vitamins in human food."

Professors Agnes Fay Morgan and Katherine Scott Bishop, for investigations of the effect of salt and antirachitic vitamin deficiencies upon reproduction in rats.

Professor Ruth Okey, for studies of metabolism of women.

The Department of Hygiene, Dr. John N. Force, *chairman*, for research in communicable diseases by members of the department as follows:

Smallpox vaccinations A survey of the potency of smallpox vaccine sold in San Francisco, by Dr. Force and Miss Eddie

A comparison between the method for potency determination suggested by Force and Leake and a modification of the intradermal method of Groth, by Professor Beattie and Miss Lorraine Worrall.

Simultaneous changes in blood and skin following smallpox vaccinations, by Miss Bernice U Eddie.

Diphtheria immunization: A series of observations on the effect of the corneal inoculation of guinea pigs with virulent diphtheria organisms, by Miss Beattie.

Relation of tonsils to infectious diseases, by Dr Cunningham

Statistical analysis of standard methods of milk counting, by Mr Brew, Miss Beattie, Miss Wakefield, and Miss Hyde

Diphtheria mortality A study of the statistical correlation between diphtheria mortality and certain population factors, Mrs Lucia.

Dr R G Aitken, associate director of the Lick Observatory, for assistants in preparing printer's copy of a General Catalogue of Double Stars

The Medical School, Professor L. S Schmitt, acting dean, for medical research by members of the staff as follows

Department of medicine Cardiovascular studies, by Dr W J Kerr and staff of the Department of Medicine

Haematological studies, by Dr E H Falconer.

Tuberculosis studies, by Dr Frederick Eberson.

Studies on the action of drugs, by Dr W J. Kerr.

Studies of the relation of salts of certain metals to the function of Langerhans' tissue in the pancreas, by Drs W. J Kerr and R. E Allen.

Department of surgery Thyroid and appendicitis studies, by Dr W. I Terry

Urological research, by Dr F Hinman and staff.

Neurosurgery, by Dr. H C. Naffziger.

Department of pediatrics Clinical studies on hypersensitiveness.

Department of obstetrics and gynecology. Studies on hemorrhage in pregnancy, carcinoma and fibroids

Professor C F. Gross, for research in mechanics in connection with the testing of models of various rudders as to shape of area.

Professors J. N. LeConte and Blake R. Vanleer, for an investigation of centrifugal pump losses.

Professors B. M. Woods and John E Younger, for the study of tailspin and wing flutter

The Department of Physics, Professor E. E. Hall, *chairman*, for research in physics by members of the department The various projects are:

Dr. S K Allison, for the measurements of the relative intensities of X-ray spectral lines from different targets.

Professor R. T. Birge and students, for studies of spectral series in the band spectra of various molecules with a special reference to the relative intensities of

the various spectral terms. For this purpose a sum of money was appropriated for the purchase of a Moll microphotometer which will also be used by Professors Brackett and Hopfield and their students

Mr. R B Brode, for studies on the free paths of electrons in gases and the process of ionization by electron impact.

Professor F S Brackett, for photographic investigations of spectra from soft X rays to the near infra red

Professor F S Brackett and students, for accurate intensity measurements of spectral lines.

Professor E Dershem, for a measurement of indices of refraction of elements of high atomic number for wave lengths between 1 and 20 angstroms

Professor E E Hall and students, for (1) a direct measurement of the distribution of atomic and molecular velocities of various substances by a modification of the revolving plate method, and (2) the electrical and thermal conductivity of metals in strong transverse and parallel magnetic fields.

Professor J J Hopfield and students, for (1) a study of emission and absorption spectra of gases and vapors in the extreme ultra-violet For this purpose, including two small vacuum spectrographs, a new 15 foot spectrograph has been built and is being put into operation. (2) The excitation of molecular spectrum of hydrogen by collisions of the second class with active nitrogen.

Mr Arthur von Hippel, International Education Board fellow, for studies on the ionization by impact of positive rays in streams of metallic vapor

Professor L T. Jones, for the study of diffusion of gaseous hydrogen through heated platinum.

Professor L. B Loeb, for a study of gaseous ion mobilities in mixtures of hydrogen with different gases

Professor L. B Loeb and A Joffe, for the direct mass determination of gaseous ions by means of a high speed centrifuge

Professor L B Loeb and students, for (1) direct measurement of the rate of recombination of ions in gases using X-ray ionization and a new method of measurement capable of investigating large ranges of ionic concentration, and (2) a direct measurement of electron attachment to neutral molecules using high frequency alternations to separate ions and electrons. (3) Application of Erikson air blast method to mobilities of ions in gaseous mixtures Also other problems involving ionic mobility cataphoresis of gas bubbles in high electric fields in non ionizing liquids and studies on the nature of mechanism of spark discharge in inert gases.

The Department of Psychology, Professor G. M. Stratton, *chairman*, for psychological research by members of the department

Professor William Popper, for a study of the Arabic text of Ibn Taghri Birdi's "Annals."

Professor Frederick J Teggart, for a study of migrations in Europe and Asia.

Professor J. F Daniel, two awards, for drawings necessary to illustrate a paper on the elasmobranch fishes, and for a study of the effects of alcohol on mice

Professor S. F. Light, for statistical investigations on termites.

The Department of Geography, Professor Carl Sauer, *chairman*, for a study of the geography of Lower California.

Professor R Schevill, for publication of a history of the Golden Age Theater in Spain

Professor John A. Marshall, for research in etiology of dental caries

Professor John B. Leighly, for a study of the Finns of the Lake Superior region

The Department of Zoology, Professor C. A Kofoid, *chairman*, for research in zoology by graduate students under the direction of the staff

Professor C A Kofoid, three awards, supplementary to grants already made to assist in a study of human intestinal Protozoa, a study of the Dinoflagellata and of the Tintinnoina of the Eastern Tropical Pacific.

The following awards were made to members of the faculty at the University of California at Los Angeles

Dr Carl Epling, for research work on the taxonomy of the Labiatae of South America

Dr. A W Haupt, for investigations on Californian Hepaticae

Dr William Newton, for a study of carbohydrate transformations in vegetable and fruit tissue

Dr O A. Plunkett, for studies on the Fungi and Myxomycetes of southern California.

Professor O L Sponsler, for research in the molecular structure of carbohydrates.

Professor A. P McKinlay, for photostats necessary in a classification of the manuscripts of Arator.

Professor Margaret S Carhart, for photostat reproductions of letters necessary in the editing of the correspondence of Joanna Baillie.

Dr C M Zierer, for a geographic study of the Ventura County, California, coastal plain

Dr C H Crickmay, for research in the delimitation of Triassic and Jurassic systems on Harbledown Island, B C

Professor W J Miller, for a study of the geology of the San Gabriel Mountains and of Deep Spring Valley, California

Professor Frank J Klingberg, for assistants in a study of the anti-slavery movement in England and the results of emancipation

Professor Louis K Koontz, for a study of the Virginia frontier, 1763–1775

Professor J M Adams, for a study of conditions governing the growth of snowflakes

Dr Glenn James, for an investigation of methods of summing series.

Professor S J Barnett, for investigations in magnetism and electrodynamics.

Professor H W. Edwards, for a determination of the number of electrons in the K and L rings of several elements by measurements of the index of refraction using X rays.

Professor J. W. Ellis, for research in infra red spectroscopy.

Professor V O. Knudsen, for studies in physiological and architectural acoustics.

Professor C G. Haines, for a comparative study of review of legislative acts by courts

Professor Ellen B Sullivan, for research in delinquency and home rehabilitation.

Dr. Gordon H Ball, for an investigation of the life histories of various intestinal Protozoa.

Professor Bennett M Allen, for research on the influence of the endocrine glands of amphibian larvae upon growth and development.

Professor John C Parish, for historical research in connection with a monograph on John Stuart and the Indian boundary line.

Professor Henry R Brush, for photostat copies of manuscripts necessary in a study of French historical poetry.

SPECIAL ARTICLES

LONG-BONE LENGTH AND BODY SIZES

In going over some bone-length, body-length relations observed in a series of albino rats used as controls for another study, it was noted that a singular consistency in ratios existed, regardless of age or body size, once the animals had passed the pre-pubertal stage of development On remarking this to Dr H H. Donaldson, of this institute, he reminded me of the idea attributed to Cuvier that it should be possible to reconstruct an animal from a single bone While I have been unable to track down this statement in the literature, the figures in the accompanying table show that the principle is not at all preposterous, providing certain obvious limitations are recognized

The ratios given in the table were derived from length measurements of the humerus, femur and body of ten or more rats of each sex of each age series from 50 days onward. The 20- and 30-day-old groups were composed of 20 animals of each sex.

The data show definitely that once puberty is established, which occurs in the albino rat at about 65 days of age, the ratios between humerus length and body length, and femur length and body length are practically constant, notwithstanding the actual increases which take place in bone and body size. Thus given a humerus or a femur of a male or female albino rat of 65 days of age or over, it is possible to compute from its length the body length of the animal from which the bone was taken, and from this the approximate body weight as well as that of the several organs, more particularly the brain and spinal cord, by the use of the "standard" values established by Donaldson.

BONE LENGTH BODY LENGTH RATIOS OF ALBINO RATS

Age in days	Male				Female			
	Body weight gm	Hum. L. / Body L.	Fem. L. / Body L.	Hum L / Fem L.	Body weight gm.	Hum L. / Body L.	Fem. L / Body L	Hum. L / Fem. L.
23	27	141	155	905	29	142	157	903
30	41	135	158	853	39	.138	162	.855
50	75	.128	159	806	74	128	159	.805
65	121	125	159	785	105	127	161	.785
75	133	125	160	785	116	127	162	.785
100	162	125	163	771	138	.127	.164	776
150	263	.126	164	765	183	127	165	.773

It will be noted that, of the two bones, the humerus length bears the more constant ratio to the body length, that of the femur tending to increase slightly with age While this increase is numerically small, its occurrence in both sexes, combined with the fact that the humerus length-femur length ratio consistently decreases with age marks the distinction as valid, and indicates that of the two the humerus is the better bone for reconstruction purposes.

FREDERICK S HAMMETT

THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY

DIETARY REQUIREMENTS FOR REPRODUCTION[1]

XII. THE INEFFICIENCY OF THE LACTATING MOTHER (MUS NORVEGICUS ALBINUS) TO SECRETE VITAMIN B IN THE MILK AND THE RELATION OF SUCH PHENOMENON TO INFANT MORTALITY

For the past eight years I have been attempting to induce lactating albino rats to rear and wean their

[1] Aided by grants from Eli Lilly and Co., Indianapolis, and the Committee on Scientific Research of the American Medical Association. Research paper No. 49, Journal Series, University of Arkansas.

young at a normal rate on synthetic diets composed of purified food substances After seven years of continuous failure I have finally succeeded during the course of the last year in these efforts, but only by increasing the Vitamin B content of the diet, in the form of alcoholic extracts of the wheat embryo, to unusually high proportions [2]

During the last few months I have perfected a quantitative biological method for the study of Vitamin B requirements for lactation. Details of the method, as well as detailed accompanying data, will soon be published elsewhere, but essentially the technique is as follows· Mothers with their litters, reduced to 6 in number, are transferred from our Stock Diet No 1[3] to the following Vitamin B-deficient ration Casein (purified), 20.0, agar-agar, 2 0; butter fat, 5 0, McCollum's salt mixture No 185, 4.0; and dextrin, 69 0 Daily records are kept of food consumption and the mothers and young are weighed daily. Each mother and litter is placed in an individual compartment containing false screen bottom so there is no access to feces, and a liberal supply of distilled water is allowed daily On such a dietary régime nursing rats will rear their litters for 10 to 12 days, during which period the mothers lose 20 to 30 per cent of their body weights The young then reach a maintenance curve, at which point we employ the curative method by administering brewer's yeast, or concentrated preparations therefrom, to the mothers quantitatively in petri dishes separately from the ration By such technique it was discovered that it is necessary to supply at least 1,500 milligrams of dehydrated brewer's yeast (the same amount of Harris yeast is required) to successfully wean our litters, and in most cases, that was accomplished only by a prolongation of the nursing period.

It was found, however, that rearing of the young could be considerably expedited if, at a certain stage in lactation when the young are able to partake of the mother's diet, the greater portion of the vitamin allowance is administered to the young instead of to the mother Fortunately, I now have access to a much more concentrated Vitamin B product from yeast than I have ever encountered before in my laboratory [4] When it became apparent that several litters were failing on 200 to 500 milligrams of the concentrated vitamin apportioned to the mother daily at an early stage of lactation when the nursing young are entirely dependent on the mother's milk, the nursing babies having developed screaming running fits and spasms, and when the paralysis beginning at the posterior quarters extended to the jaws, so that they could swallow only with great difficulty, the greater portion of the vitamin dosage allowed the mother was then administered to the young in aqueous solution with a medicine dropper. The first response was almost immediate. The convulsive young overcame their spasms in less than two minutes, and could swallow readily in five minutes It was then an easy matter to give the young the rest of the vitamin dosage In a few hours the young were observed nursing and on the next morning playing cheerfully in the cage. The young were successfully weaned in 7 to 10 days

We find there is an optimum requirement of Vitamin B for mother and young during different stages of lactation, the amounts depending on the condition of the mother and the age of the young

At this writing we are having unusual success with a Vitamin B concentrate with a daily dosage of only 50 to 65 milligrams by distributing the vitamin between mother and young according to needs

We have now perfected our technique so we can save baby rats just a little over one third of an ounce in weight, still blind, lying flat on their backs or sides constantly nursing, and this procedure we adopt only when it is determined that the mother is dissipating considerable of the vitamin dosage apportioned to her in the metabolism of transfer to the milk. The results are remarkably successful.

It is quite possible that a large proportion of the infant mortality associated with gastro-intestinal disturbances during the first year of life may be due to Vitamin B deficiencies. Such vitamin deficiencies may be brought about by the character of the present American diet, which is composed largely of degerminated cereals, sugar, and meat, and in addition by the physiological inability of the nursing mother to secrete her daily Vitamin B intake quantitatively and rapidly into the milk indispensable for infant nutrition and welfare. Pediatricians already recognize the needs of cod liver oil, and orange or tomato juice for infants to furnish Vitamins A, D, and C. No provision is as yet, however, being made for Vitamin B therapy.

This communication is essentially preliminary in character and the detailed data will appear in scientific journals.

BARNETT SURE
DEPARTMENT OF AGRICULTURAL CHEMISTRY,
UNIVERSITY OF ARKANSAS,
FAYETTEVILLE, ARK.

[2] Sure, B, J Biol Chem., 1927, lxxiv, 55–69.

[3] *Ibid*, lxxiv, 49

[4] This concentrate was prepared for me by Mr E. H. Stuart, chemist of the Eli Lilly Research Laboratories, Indianapolis, Ind.

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LISTER AS PHYSIOLOGIST[1]

IN his article on Baron Lister in the eleventh edition of the Encyclopaedia Britannica, Sir Clifford Allbutt says that Lister, appraising his own work, once stated that he had done no more than seize upon the discoveries of the great French scientist, Louis Pasteur, and apply these discoveries to surgery. The writer of the article then goes on to say, "But though Lister saw the vast importance of the discoveries of Pasteur, he saw it because he was watching on the heights, and he was watching there alone." How are we to account for the unique preparedness of Lister to lay hold of the revolutionary work of Pasteur and to apply it with such momentous effect to the treatment of surgical wounds? How had he reached those heights on which he stood watching alone?

The various biographical accounts of Lister all contain references to the early physiological work that he carried out. They make plain that he approached his surgical problems with the peculiar experimental outlook that is acquired through physiological training. In his Huxley lecture delivered in 1900 before the Medical School of Charing Cross Hospital he gives a charming review of these introductory researches, and thus outlines the influences that were brought to bear upon him at the commencement of his career:

> As a student at University College I was greatly attracted by Dr. Sharpey's lectures, which inspired me with a love of physiology that has never left me. My father, whose labours had raised the compound microscope from little better than a scientific toy to the powerful engine for investigation which it then was, had equipped me with a first rate instrument of that kind, and I employed it with keen interest in verifying the details of histology brought before us by our great master. When I afterwards became house surgeon under Mr. Erichsen, I applied the same means of observation to pathological objects.

In other words, through physiology and physiological investigation Lister became what we should now call an experimental pathologist.

Let me digress for a moment to speak of some of his teachers. He makes mention of his father's improvements on the microscope. The father, a London wine merchant, a skilled mathematician and a world-renowned expert on optics, was a fellow of the Royal Society and known to a large circle of scientific people, biologists and astronomers. He had once col-

[1] Lister Centenary address delivered in the Moyse Hall, McGill University, Montreal, April 5, 1927.

laborated with the physician Hodgkin in microscopic examination of the red cells of the blood. Those two men together first established the real shape of the red corpuscles, and described their peculiar aggregation in rouleaux (1827).

When the son at the age of twenty-one began his medical course at University College, London, he came under the influence of some unusually able teachers One was the professor of chemistry, Thomas Graham, whose work on colloids and on diffusion of gases has made his name so famous The influence of Graham may be detected in many of Lister's subsequent papers. The men, however, to whom he owed most in the way of direct inspiration were Wharton Jones, professor of ophthalmic medicine and surgery, and William Sharpey, professor of physiology

Wharton Jones, a shy, retiring and somewhat eccentric man, little known to the world at large but held in high esteem by a circle of intimate acquaintances who understood his scientific quality, devoted all the leisure that he could spare from practice to physiological inquiry, working particularly on the blood and on the circulatory system To him, the original discoverer of amoeboid movement in the blood leucocytes, we owe an elaborate and comprehensive survey of these cells, which he classified into two main varieties, hyaline and granular, distinguishable not only by their appearance and configuration but also by their behavior on a glass slide This work, published in 1846, *i e*, when Lister was a student, forms the foundation of all our subsequent knowledge of these interesting and vitally important blood elements. His researches on inflammation were the direct means of inducing Lister subsequently to pursue the subject

Lister's chief incitement to scientific investigation came from William Sharpey, to whom his country owes a lasting debt as the outstanding exponent of the experimental method in biology at a time when England lagged far behind her continental neighbors in such inquiries By the unwonted clarity, by the stimulating quality of his lecture-room exposition, combined with a wide knowledge of the history of the subject down to its latest continental developments, Sharpey was able to inspire his listeners with a profound and often lifelong interest in physiological science. The Germans trace the great upgrowth of physiology in their country during the middle and latter half of the nineteenth century to Johannes Müller, of Berlin The English trace the subsequent great rise of physiology in their country directly to Sharpey He trained the physiologists, *e g*, Sir Michael Foster, Sir John Burdon Sanderson, Sir Edward Sharpey-Schafer, who, by their own work, by the schools they founded and the pupils they in turn sent out, established English physiology, and (through Newell Martin, Foster's pupil, who went to Johns Hopkins) created American experimental biology. Sharpey's influence was not limited to the aspirants to a career in physiology. Men in other branches of medicine, like the surgeon Lister, even men in other walks of life altogether, were profoundly affected by his teaching One of the proudest boasts of our own Dean Moyse, in whose honor this beautiful hall is named, was that when a student at University College he took Sharpey's lectures on physiology.

It was on Sharpey's advice that Lister, intent on the pursuit of surgery, proceeded to Edinburgh after receiving his London degree, in order to study under Syme The story of Lister's rapid promotion there is known perhaps to most of us. What I wish to speak of this morning is the astonishingly original and important physiological work that he proceeded to carry out in Edinburgh before he was led to the final and greater discovery that has made his name live forever When referring in his Huxley lecture of 1900 to this preliminary work, he speaks of it—not without a whimsical touch of regret—as being "probably little known to the present generation" One of the curious enigmas of scientific history is the slight attention that has hitherto been paid, even by professional physiologists, not to speak of his numerous clinical biographers, to the quality and importance of his investigations in pure physiology Undertaken mainly in order that he might be able to speak to his students at first hand of the complicated processes involved, he had to make a strenuous effort simply to find the time for these wholly self-imposed researches Much of the work was done with the help of his wife, in the back kitchen of the dwelling in Rutland Street in which they started housekeeping. When these early investigations, unexcelled in their experimental quality and in the depth of insight they display, have been properly appraised—and it is beyond the capacity of any one to do so in a brief memorial lecture—we shall be able to see Joseph Lister for the first time in his real greatness. Wide as was the range of these researches—they include the structure of plain muscle, the structure of nerve fibers, the flow of the lacteal fluid in the mesentery, nervous regulation of the arteries, function of the visceral nerves, inflammation, coagulation of the blood, the cutaneous pigmentary system of the frog—wide as was their range, hardly one of his conclusions requires alteration or amendment to-day. Some of his results that I might readily name still await exploitation, having remained untouched and undeveloped at the point where he then left them.

In order to give a conception of Lister's experimental power and insight, one might select at random

almost any aspect of these neglected researches and, by analysis of the contribution thus chosen, demonstrate the high place he achieved for himself in that particular field I propose to adopt this method and to take his work on blood coagulation on the simple ground that I happen to be rather familiar with all its various antecedents, with its history up to the time of Lister, and after

The problem of blood coagulation occupies a central position in medicine It interests not only the physiologist and the pathologist but the practising physician, the surgeon, the obstetrician, and all in equal degree Having extensive ramifications, it is also far from being a simple problem In reporting on the question before the Royal Society of London in 1863 Lister says "My difficulty on the present occasion does not depend so much on the lack of materials as on the complicated relations of the subject, which makes me almost despair of being able, in the short time that can be devoted to a lecture, to give, in anything like an intelligible form, even an adequate selection of the facts at my disposal"

When Lister came to the blood coagulation problem, the outstanding point of interest in the question was, "What induces the blood to clot when it comes out of the body? What first pulls the trigger, as it were, and sets in play the chain of events by which it inevitably changes from a fluid to a solid?" You may seek an answer to this apparently simple question in any of our modern text-books of physiology Either the issue is avoided, or, if it is handled, you will be put off with carefully guarded answers, full of caveats and qualifications The books are so anxious to describe the complex composition of the gunpowder that they forget about the percussion cap that is necessary to touch it off. We shall see with what result Lister worked at the question—but then, as I said, Lister's contribution to the subject is forgotten

The problem, as presented to him, had taken scientific shape some ninety years before (between 1770 and 1776) at the hands of a brilliant investigator, William Hewson, whose untimely death at the age of thirty-six was a great loss to English physiology. Let us throw our minds backwards and picture the problem as it presented itself to the medical men of Hewson's time.

The blood comes out of the vessels It is exposed to the *air*. What more simple than to suppose that the air acts on it?

Or, if you like, it *cools down*. We know that a solution of gelatine tends to set when it cools

Again, the blood has come to a standstill. Whipped up in the circulation and kept in constant motion, one part gliding over another, it may have no opportunity, as it were, to stiffen It might be that the simple condition of *rest* induces coagulation

All these hypotheses—exposure to air, cooling, rest—had by one person or another been advanced as explanations. It was the merit of Hewson, along with other fundamental work on blood coagulation, first to devise and execute definite experiments to test these several hypotheses. He showed that cooling, instead of hastening, actually retards coagulation He rapidly froze the blood, thawed it, froze it again, thawed it; it stayed fluid. He warmed it up, it clotted A different matter this from any solution of gelatine.

In order to test the effect of rest, Hewson ligatured veins in two places, thus bringing the intervening column of blood to a standstill Often enough no coagulation, but the results were variable and his conclusions indefinite On the other hand, he could get no valid evidence that mere exposure of the blood to air has the slightest effect upon it. John Hunter made this matter still more definite. He received blood directly from a vessel into a Torricellian vacuum, where it clotted with particular promptitude

Here was a difficult impasse As no condition that one could reasonably think of seemed to be the cause, the London surgeon, Sir Astley Cooper, then made a new suggestion. "What if blood, wheresoever it be, has a natural tendency to clot? The impulse to coagulation may not be communicated by any external influence It may be inherent in the blood, being constantly held in check by the vital action of the vessels." Cooper, as you see, simply inverted the issue. On his supposition there was no need to search for any new condition that acts upon the extravasated blood What we require to explain—if the matter be susceptible of explanation at all—is not so much the fact of coagulation as the process by which the vessels succeed in keeping the blood fluid

Sir Astley Cooper carried out no experiments. He merely promulgated a new idea However, a young graduate who had studied under Cooper, by name Turner Thackrah, decided to take up the whole question afresh Thackrah's important connection with the problem, like that of Lister, is little known to writers on blood coagulation. He was stimulated partly by his interest in the subject, partly by the fact that a valuable prize, the Sir Astley Cooper Prize, had been offered for the best essay on the subject of blood coagulation. In his consulting room at Leeds, where he had set up in practice, Thackrah worked away at his chosen problem Fighting against tuberculosis, he died at the age of twenty-eight, but not before he had won the prize and left a memoir on blood coagulation which reveals that he was an experimentalist of a very high order. After his work

there could be no question of air, rest or cooling as causes of coagulation In the end he was driven, one can see doubtfully and with no fervor of conviction, to the provisional conclusion that Astley Cooper's hypothesis best fitted the conflicting facts Thackrah's essay was published in 1819

In 1857 the subject set for the Astley Cooper Prize was again that of blood coagulation Two essays were sent in, one by Dr Richardson (later Sir Benjamin Ward Richardson, of public health fame), the other by Ernst von Brucke, professor of physiology in Vienna The committee awarded the prize to Richardson, who advanced a new conception, viz, that the blood is kept fluid by a slight content of ammonia, the escape of which, when the blood is shed, allows the onset of coagulation. A somewhat analogous idea, involving, however, the gas carbon dioxide instead of ammonia, had been previously advocated with some apparent experimental support by Sir Charles Scudamore.

Brucke took his stand on Thackrah's work, which he greatly amplified and extended In speaking of Thackrah's essay he says. "Surely no essay was ever more deserving of a prize" The final conclusion of Brücke, again hesitant, but adopted because he could see no other reasonable way out, was purposely phrased almost in Thackrah's own words "The influence of the living heart and vessels is the source of the blood's fluidity, and its loss the cause of coagulation." Brucke's experimental findings, widely published and also incorporated in his own text-book of physiology, subsequently exercised much influence in Austria and in Germany

At this stage, during the excitement of the Astley Cooper award, which caused rather an unusual flurry, enter Joseph Lister He had read and studied Hewson and John Hunter he had read Sir Charles Scudamore, Richardson and also Brucke. His first experiments were directed to an examination of Richardson's work, and it was some time before he was able to shake himself quite free of the ammonia theory. As usual, when he had to set aside an alluring and highly circumstantial hypothesis, he did so only after piling up overwhelming evidence against it In order to preclude all escape of ammonia, a rubber tube, filled with a succession of short segments of glass tube, is looped and tied into a vein The blood courses through All the little glass sections are then separately ligated and the tube is removed. Confined in this way the blood clots just as quickly as when exposed to the air Again, coagulation is known to be promoted when the blood is stirred with a rod. The stirring, according to Richardson, gives better opportunity for escape of ammonia. By means of an ingenious and complicated piece of apparatus Lister arranges to collect blood and to stir it without any possibility of ammonia escape. The mere stirring is found to accelerate coagulation. But I should weary you with those experiments on the ammonia hypothesis Lister took much more than an hour to read his own paper I have to be more brief.

Let us stop for a moment to picture him at work. As first assistant to Syme and later as full professor of surgery in Glasgow, he is subject to sudden call at any hour of the day or night. He has his own private patients He has his lectures to prepare, constant infirmary duties, engagements of various kinds to keep. He must have gone from place to place, his mind constantly preoccupied with the particular research on hand, and we must also keep in mind the mere quantity of first-class physiological work that he turned out. The marvel is that he could find time to test his fructifying schemes and ideas. Fortunately, the slaughter-house is not far away. The veterinary college, where horses are killed, is also within easy walking distance. He goes to the slaughter-house, makes friends with the butchers Sheep are being killed He ties ligatures round their limbs, so as to cause venous congestion, and when the trotters are removed, he gathers them in his bag and hurries off to the back kitchen, where his wife has things ready for him. Or he learns that a horse is to be killed at the veterinary college. He goes there and secures the jugular veins filled with blood. Those who knew Lister tell us that his whole life was one endless succession of experiments When later his attention was concentrated more upon wounds and upon dressings, he devoted infinite trouble to the selection of the best materials, trying and discarding scores of different things until he got the very best. He constantly went about with dressings and bandages on his own person It may be news to some of the students of this audience that the introduction of all our routine surgical dressings—lint, gauze, absorbent wool, domet bandages, not to speak of the absorbable catgut to which he devoted so many years of patient labor—is due entirely to Lister's ceaseless experimentation.

Having disposed of the ammonia hypothesis, Lister next turned his attention to Brücke's conclusion that the influence of the living heart and vessels is the cause of the blood's fluidity. He set himself to devise some method of withdrawing it from this influence and, if possible, still keeping it fluid. The blood in the ligated vein of a horse stays fluid. Suspend the ligated vein, open it carefully and look down. The blood remains unchanged. Thanks to the work of the German physiologist, Henle, Lister knew that all the vessels have an inner lining of extremely deli-

cate flattened cells, which we now call endothelium. It might be possible to make cups of these large veins, and pour the blood from one to another through the air. He makes wire frames, sews the outer wall of the vein to these frames, turns down the top edge like a lip, and pours. In this passage through the air the blood is temporarily removed from the vital influence of the vessel—and he may go on pouring, alternately from one to the other—yet the blood does not clot The evidence is still not conclusive, for the removal has been only temporary The visceral cavity of the frog, with which blood does not ordinarily come in contact, is however lined with endothelium He anesthetizes a frog, which is laid on its back, he opens the abdomen, pins the wall upwards and outwards, and makes a snip into the heart The blood wells out into the endothelium-lined cavity It does not clot The same blood, pipetted out of the abdomen into a glass tube, coagulates Plainly the issue narrows itself down to some difference between such a material as glass and endothelium

Whenever coagulation had occurred one and the same condition had always been present. The blood had touched some foreign material[8] He dips a solid rod into the fluid blood contained in an open vein A crust of clot forms around the rod He pushes needles into the veins of his sheep trotters, around the needle the blood coagulates, but not elsewhere To make a long story short—and I can only refer you to his original paper for the wealth of detail and the ingenious variation of experiment by which he drives home the evidence—the cause of coagulation is neither more nor less than contact of the blood with extraneous foreign matter The more effective the means taken to secure this contact, as by agitation or stirring, the more rapidly it clots Here was some extraordinary influence, hard to explain on a physical basis, indubitably exerted by a mere touch with particular kinds of material. What this influence was he could only surmise. His training under Thomas Graham suggested some process of a catalytic nature. On the other hand, the absence of coagulation in the uninjured vessel shows merely that the endothelium is curiously and wholly neutral with regard to the process. It exerts no vital influence

His next step was to demonstrate that the cells of the blood are implicated in the process, for in the absence of blood cells he could show that contact with foreign matter is powerless to cause coagulation But at this critical and important stage he had to lay the matter aside. When he did return to it for a brief period in his later life, he proved that the influence which suffices to determine solid coagulation of the blood outside the body fails to act in the same way upon the circulating blood. The circulatory system contains some mechanism for protection against accidental intravascular coagulation But I must not pursue the subsequent history of this fascinating subject. My object is to give some conception, however inadequate, of Lister's originality and amazing turn for experiment, in illustration of which I might equally well have selected almost any other of the physiological subjects that he handled at this commencing period of his career Every touch of his work indicates the master hand

[8] This suggestion, first mooted by Thackrah, had been more elaborately handled by Brücke, who finally, but not without qualification, discarded it.

Those of you who have visited Edinburgh may perhaps have wandered into the Library Hall of the old Arts Building of the university There, close beside the octagonal table that Napoleon used at St Helena, is another oblong table surmounted by a glass case containing the various distinctions and decorations that were eventually showered upon Lister by the world at large Here are his medals, here the different orders conferred upon him by his own and by foreign countries; and here the beautiful casket that was presented to him when he was awarded the freedom of his native city of London When at the end of his career he came to look back over the scenes of his struggles and of his hard-won victories, Lister decided that Edinburgh should be the repository of these unique tributes There, under Syme, he had had his first full introduction to surgery, there he had courted and married Agnes Syme, the devoted companion of all his vicissitudes, there he had renounced his Quaker connection and joined the Church of England, from the University of Edinburgh had come William Sharpey and Wharton Jones, his London teachers, above all it was in Edinburgh that he had realized himself and learned to trust his own powers, there, experiencing all the alternating joy and disappointment, all the strong excitement of intensely interesting yet highly difficult scientific investigation, he had climbed those heights from which, without hesitation and with immediate comprehension he was in his turn to signal the beacon light that suddenly shone across from France It is into his early struggles that a man puts, if not his best, at least his most significant effort, and just as Sir William Osler, looking back over his nomadic and meteoric career in three countries, decides that his ashes and his library, to the making of which he had devoted a lifetime, shall find a repository in McGill, where he had polished the weapons that carried him to his later triumphs, so did Lister feel that the scene of his scientific self-realization should retain those proud

insignia of homage that the nations had vied with each other in conferring upon him

As time goes on, we shall come more and more to recognize in Lister an experimental genius of the first order His trouble was that, being in every instance years in advance of his time, among men of lesser mould he was apt to be misunderstood He had no gift of brilliant exposition by which he could rivet the attention of an indifferent public, and, with his innate modesty of nature, he had to rely for his ultimate vindication simply upon strenuous application to the work of his choice The young assistants who loyally banded themselves around him, perceiving his merit, his sterling honesty to fact and the astonishing success of his methods, could guess at but could scarcely analyze his mental processes They called him "a great thinker" They saw the outward Lister, they could not quite see what Wordsworth calls "the very pulse of the machine." There was, however, one experienced eye that had followed Lister's career from stage to stage with unabating interest. There was one man who could appreciate and closely follow every single experimental step he took That was Sharpey It was to Sharpey that the eager young student had first come with his microscope, seeking to examine for himself the structures of which the teacher spoke It was Sharpey who had encouraged, advised and stood by him from the beginning, and before this inspiring and trusted counsellor died in 1880, he had the quiet satisfaction of knowing that his brilliant pupil had made what would probably prove to be one of the world's greatest discoveries.

JOHN TAIT

McGILL UNIVERSITY,
MONTREAL

CHANNELS, VALLEYS AND INTERMONT DETRITAL PLAINS

AN article in the March number of the *American Journal of Science* by O F Evans on the "Origin of Certain Stream Valleys " describes a common type of valley in the interior-plains region as having "a broad flood plain with a deep narrow trench winding through it" Is not this "trench" simply the river channel, filled to overflowing at time of flood, and occupied only by a dwindling, channel-bed stream during the rest of the year? In arid regions the prevailingly empty river channels, the beds of which are either dry or are followed only by the small flow of their low-water streams, contrast strongly with the well-filled river channels of humid regions, where a relatively constant flow covers all the channel bed and rises well on the channel banks. The most striking case of the arid-region kind that I have seen is in the interior of South Africa, where a channel over 100 feet in width at the rim and perhaps 30 or 40 feet in depth had, at the dry-season time of my visit, every appearance of a young valley, new-cut in a plain in consequence of river juvenation by uplift or otherwise, so deep was the channel bed below the surface of the plain and so small was the trickling stream that ran along the bed. Yet residents there assured me that, at time of great floods, the little stream expands until it fills the whole valley-like channel and overflows on the plain in which the channel is incised Such a channel is truly trench-like, but it is nothing more than a channel after all. Its impressively large dimensions result simply enough from the great difference in volume of its river in low-water and in flood stages Hence, unless the typical valleys described in the above-cited article are peculiar in some unspecified respect, it seems undesirable to adopt a new name, like trench, for their river channels. It would be unnecessarily redundant to have two names for one thing

It is, on the other hand, true that we seem sometimes to have only one name for two geographical things, and there the poverty of our language in respect to appropriate names for the two features is embarrassing. For example, those lop-sided ridges which mark the outcrop of gently inclined, hard formations between more worn-down, weaker formations were long without any one-word name, until Hill of Texas introduced the Spanish word "cuesta" to designate them They had previously been unsatisfactorily called "escarpments" by British geographers, who thus gave to the whole form the same name that is applied to one of its parts, namely, to the steep outcrop face of the determining hard formation, in contrast to the arched upland of the crest and the long and gentle declivity of the back slope Cuesta is now coming to be more and more generally accepted as the technical, generic name for such forms.

But the poverty of our geographical terminology is sometimes rather apparent than real Such is the case when a single name is used for two unlike features, although separate names are really available for them. Thus it is to-day customary in the Great Basin province to call the broad intermont detrital areas "valleys," as if the simple name, "plains," were not applicable to them and as if the equally simple name, "valleys," were not already fully enough employed in designating linear depressions, excavated under the guidance of streams or rivers, which are, like rivers, arranged in systems, with twig joining branch and branch joining trunk in down-grade suc-

cession. Unmindful of the earlier preemption of "valley" for forms of such erosional origin, that term is now taken over in the west to name broad and smooth surfaces of depositional origin.

For example, the extensive detrital plain in central Arizona, now redeemed from its original desert condition by irrigation from the waters of Salt River stored by the Roosevelt Dam in the mountains farther east and thereby converted into a superb oasis around Phoenix, the capital of the state, is universally called "Salt River Valley" by its prosperous residents Yet the plain of the oasis seems level to the eye, except where rocky buttes of smaller or larger size rise through it, and it really has the form of a very broad and gently sloping alluvial fan. If the fan is crossed on a line transverse to its mid-rib, the surface is found to be faintly but characteristically convex Its alluvial deposits are of great thickness, one of the many wells driven in them is 1,500 feet deep without reaching the solid rock of the depressed basin floor The agricultural value of the apparently level irrigated area depends largely upon its possession of the regular and gentle, radially disposed slope that the fans of good-sized streams are necessarily given as they are built up, for in consequence of that slope, the construction of the canals which lead the stored-up water from the river, as it issues from the mountains, to all parts of the great oasis has not involved any great work of cutting or filling, and the fields into which the oasis is now subdivided are easily irrigated from the canals without regrading, by reason of their gentle slope

As one drives over the plain, it seems geographically ludicrous to call it a "valley," yet there is no likelihood that the misnomer will be abandoned Indeed the official map of Arizona shows that the name "valley" is repeatedly applied to the broad and desert intermont plains which occupy so large a share of its southwestern half Further embarrassment arises from the fact that the plains are not infrequently traversed by valleys of small or moderate depth, which have been excavated in normal fashion by the intermittent rivers of the region; and these are unquestionably true erosional valleys, for they possess the four elements of form by which such valleys are known; namely, limiting side slopes, more or less frayed out by lateral wash, a smooth floor sometimes showing flat strips in faintly terraced arrangement, the lowest strip being the flood plain of to-day, a channel in the flood plain, usually dry but occasionally filled to overflowing; and a continuous down-stream slope. A fifth element of form, the reception of branch valleys at accordant level, is often added The Gila, that long and slender tributary of the Colorado which crosses two states in a flow of irregularly increasing and decreasing volume, frequently follows shallow, gently terraced valleys of this kind, which it has slightly excavated in the broad intermont detrited plains; one such valley characterizes its course near certain isolated mountain ranges, some miles to the southwest of Phoenix, where the river has been driven by the fan of Salt River above mentioned.

On the other hand, the San Pedro, an affluent of the Gila which rises in the southeastern part of Arizona, has excavated a valley several hundred feet deep—one of the deepest of its kind in the state—in its northward course along the axis of a well-defined and heavily aggraded intermont trough The width of this valley is much increased and its sides are much frayed out by many lateral wet-weather washes, as may be well seen from the main line and from the Douglas loop of the Southern Pacific railway, and from several state highways In both these cases, the change from a former phase of aggradation to the present phase of excavation appears to be associated with the maturing of the Gila river system as a whole, but that is another story. Certain small and recent, but problematic changes in the channels of valleys of this kind have been lately discussed by K. Bryan In view of the occurrence of these normal excavations, it is doubly unfortunate that the term, valley, is so generally used to designate not the excavations, but the intermont plains in which the excavations have been made. The proper term, plain, is thereby displaced from the aggraded surfaces which it names so well, and the term, valley, is misplaced from the erosional features to which it should be applied

The numerous and extensive intermont detrital plains of the Great Basin province usually exhibit well-defined but gently inclined slopes of relatively coarse gravels, slanting forward from the base of the enclosing mountains and uniting in a broad, medial floor of finer soil and nearly level surface. The medial floor may or may not be incised by a true valley When one stands on either detrital slope of such an intermont plain, an open view is afforded all across the medial floor to the opposite detrital slope, except that in plains of unusually great width, the opposite detrital slope may be lost in the distance. And from any part of the medial floor, which is everywhere lower than the detrital slopes that slant down to it, an open view is afforded of the gradual ascent by which the detrital slopes rise to the mountains. The slopes thus seen gain an appearance of exaggerated steepness by foreshortening. In the southeasternmost county of Arizona, the city of Douglas, where copper ore is smelted for Bisbee, a mining city that is crowded in a

steep-sided valley in the near-by mountains, has plenty of room for growth on a typical intermont detrital plain, but the plain is unfortunately known as Sulphur Springs Valley. Hence no generic name is left for the true though narrow and shallow valley that is excavated in the plain by the ephemeral wet-weather drainage which flows southward into Mexico When one looks northward along the smooth medial floor of the plain, it seems to rise gradually to the skyline, as if in a distant ridge, but the ridge recedes as one travels towards it, it is simply the ocean-like horizon of the nearly level surface

The intermont detrital plain on which the flourishing residential and university city of Tucson stands, not so near the southeastern corner of Arizona as Douglas by about 100 miles, occupies a well-aggraded intermont basin of depression, which departs in a peculiar manner from the typical form that is seen in the Sulphur Springs Plain The detrital slopes that slant forward from the encircling mountains around Tucson are clearly enough seen when one is near them, but they are out of sight from a good part of the plain between them, which is not level but has a gently undulating surface, as if it had recently been warped Its faint swells and hollows, well exhibited for several miles next north and east of Tucson, are clearly unlike the shallow valleys that have elsewhere been normally excavated a little below the surface of the plain by several small intermittent rivers The undulations are frequently strong enough to hide a cross-plain view of the piedmont slopes, indeed, if one stands in the center of a faint hollow, the outward view, instead of being unobstructed for many miles as it should be on the medial floor of an undisturbed plain, is rather closely circumscribed in nearly all directions, as it should not be

Some justification for attributing the faint swells and hollows of the Tucson plain to deformational warping is found in the southeastern part of the same intermont basin, where the detrital deposits are clearly seen to have been strongly tilted and elaborately dissected and degraded since their deposition The plain in the neighborhood of Tucson must have been deformed at a later date than this dissected southeastern extension of the intermont area, for it is practically undissected, except along the margins of its normal valleys Another indication of warping is found in the present course of the Rillito, a wet-weather stream that flows westward across the aggraded basin not far north of Tucson and but a few miles south of the Santa Catalina Mountains, the highest of the enclosing ranges. The stream ought to have been pushed much farther away from these mountains by the abundant outwash of detritus that their deep-cut, steep-sided valleys have supplied to the intermont area; but the deformational warping appears to have compelled the stream to shift northward toward the mountains, in spite of the detrital outwash from them. In consequence of that shift, the piedmont detrital slope is sharply undercut by the northward encroachment of the stream upon it, and its dissection by washes from the mountains is thus promoted to an exceptional degree The deformation of the plain seems, indeed, to have extended beyond the west-flowing Rillito, for between its contrained course and the base of the mountains, the detrital slope has assumed various irregular forms with a relief of 200 or 300 feet Yet 20 or 30 miles farther west, the intermont plain has a strikingly level surface and so continues much farther, as if it were there in process of undisturbed aggradation.

There is, as above noted, little likelihood that the people of Arizona will change the nomenclature that has been so unsystematically applied to the intermont detrital plains on which many of them live, but for geographical purposes it is eminently desirable to call the plains by their proper name, and to recognize their subdivision into piedmont slopes and medial floors, as well as the not infrequent excavation of true valleys across them, and to recognize also the warping by which at least one of them seems to be gently deformed

W. M. DAVIS

HARVARD UNIVERSITY

SCIENTIFIC EVENTS

THE ELEVENTH EXPOSITION OF CHEMICAL INDUSTRIES[1]

WHEN the doors of the Eleventh Exposition of Chemical Industries are opened on September 26, those who will avail themselves of the opportunity will be impressed by the large number of diverse exhibits which will show something of the tremendous advancement that has been made, thanks to the continued application of science in cooperation with sound finance. Some 350 exhibitors will display a wide range of chemicals, chemical products and the apparatus, equipment and scientific instruments used in producing them, as well as many of the required raw materials.

The exhibits will be chiefly from this country, but there will be many representatives of foreign activities The raw materials to be shown are from the Southern, the Southwestern and the Pacific States, and from the Dominion of Canada, displayed by government departments and railroads concerned with the industrial development of their territory. The section of chemical and chemical product exhibits is three times as numerous as five years ago. The machinery

[1] *Industrial and Engineering Chemistry.*

exhibit has increased in number and variety The instruments exhibits will show marked strides in accuracy, application, simplicity and usefulness In addition, there are sections devoted to laboratory supplies and equipment, to containers, packaging, labeling and shipping, to plastic compositions, to transportation, and to material handling

Statistics of the sections specializing in laboratory equipment and supplies will give an impression of the scope of the present exposition, the number indicating the units in this section laboratory furniture, 7, general laboratory apparatus and supplies, 7, special equipment, 13, balances, 3, research chemicals, 9, platinum ware, 3, glass, porcelain and silica ware, 9, filter-paper, 3, optical instruments, 3, electrical apparatus, 3, thermal precision instruments, 6, engineering equipment, 13, and publishers, 9

The United States Government has prepared exhibits showing the work of three of its principal departments The War Department will be represented by an exhibit from Chemical Warfare Service The Department of Commerce will be represented by the Bureaus of the Census, Mines, Standards and Foreign and Domestic Commerce and the Committee on Wood Utilization, the Department of Agriculture by the Bureaus of Chemistry and Soils, including the Fixed Nitrogen Research Laboratory, Animal Industry, Forest Service and others The National Safety Council will present, in complete form, the recently concluded exhaustive study on hazards caused by benzene when used in products designed for manufacturing and domestic use There will be other educational exhibits and booths arranged by scientific societies, prominent among which will be that of the American Chemical Society

The educational features of the exposition include an excellent program of motion pictures, the students' courses and meetings of certain scientific societies The students' courses—a unique feature of this exposition—have become established and will be attended by representatives of many educational institutions of this and other countries

The Fifth Chemical Industries Banquet will be held during the exposition on Wednesday evening, September 28, under the auspices of the Salesmen's Association of the American Chemical Industry, sponsored by the American Ceramic Society, New Jersey and New York Sections of the American Chemical Society, New York Section of the American Electrochemical Society, Chemical Warfare Association, Chemists' Club, Pressed Gas Manufacturers' Association, Chlorine Institute, American Institute of Chemical Engineers, American Leather Chemists' Association, Manufacturing Chemists Association, Société de Chimie Industrielle, Society of Chemical Industry, American Society for Testing Materials, American Association of Textile Chemists and Colorists, Synthetic Organic Chemical Manufacturers' Association and the Technical Association of the Pulp and Paper Industry, at the Hotel Roosevelt

THE KANSAS GEOLOGICAL FIELD CONFERENCE

THE annual field conference of the Kansas Geological Society was held in northeastern Missouri, eastern Iowa and adjacent parts of Illinois and Wisconsin, from September 5 to September 10 About forty geologists participated The object of the conference was to study the outcrops on the surface of the lower Paleozoic rocks, especially the Ordovician and the Mississippian, in the regions visited

The party assembled at Columbia, Missouri, and on the morning of the fifth, started out under the direction of Professor E B Branson, of the department of geology of the University of Missouri For three days studies were made along the bluffs of the Missouri and Mississippi Rivers and their tributaries, in northeastern Missouri, night stops being made at St Louis and Hannibal

At Burlington, Iowa, the party was joined by Dr George F Kay, state geologist of Iowa, with his assistants, and for three days Dr Kay, Dr O A Thomas and G Marshall Kay conducted the party through eastern Iowa and adjacent parts of Illinois and Wisconsin

The chief object of the trip was to correlate the various exposures which occur in northeastern Missouri and eastern Iowa with various formations encountered by deep drilling in central Kansas and northern Oklahoma The oil-bearing sand, which in these latter states is known as the Wilcox sand, and which is the chief producer in a number of Oklahoma and Kansas oil wells, is believed to be the approximate equivalent of the St Peter sandstone, of the states visited The Decorah shales which contain certain typical fossils and are easily recognized in many of the deep wells in Kansas, was first named more than fifty years ago at Decorah in northeastern Iowa

One of the principal points brought out on this conference is the intimate relation between pure science and practical affairs Twenty years ago, or even five years ago, geologists would not have thought of traveling hundreds of miles to study outcrops of fossil-bearing rocks, in order to understand and interpret well logs in distant states

The personnel of the party consisted of State Geologists Kay, of Iowa, Condra, of Nebraska, Moore, of Kansas, and Gould, of Oklahoma, also Professors

Dunbar, of Yale, R T Chamberlin, of Chicago, Branson and Mehl, of Missouri, and Bridge, of the Missouri School of Mines In addition there were more than twenty petroleum geologists from Kansas and Oklahoma To L W Kesler, of Wichita, president of the Kansas Geological Society, is due much of the credit for the success of the conference

THE COMMITTEE ON SEISMOLOGY OF THE BRITISH ASSOCIATION

For thirty-one years a committee appointed by the British Association has published an annual report on seismological investigation Under the chairmanship of Professor H H Turner, it works in close association with an international body which with financial help from the Royal Society is trying to bring up to date summaries of the observed details of earthquakes all over the world Summaries up to the end of 1923 have been issued, and those for the greater part of 1924 are well in hand From these exact knowledge of the transmission of earthquake shocks is gradually being obtained, and the existence of anomalous cases is being verified

When it happens that there are a number of good recording stations reasonably near the center of an earthquake, special information can be derived from their records as to the nature of the upper layers of the earth's crust The Jersey and Hereford earthquakes of 1926 yielded specially useful results in that respect British earthquakes have been rare, but in August, 1926, there was one at Hereford and Ludlow, on January 24, 1927, one in Scotland and on February 17 last one in Jersey Yorkshire appears to have had an earthquake at Tadcaster on a recent evening, but seismological apparatus is not of a kind that can be carried about, and the members of the committee in their report to the section were reticent as to this manifestation.

The committee reported that the Palestine earthquake of July 11, although serious and causing much local injury and many deaths, was not of unusual violence The intensity of its indications on the Oxford seismograms was much less than in the case of the earthquake in China on May 22, although the latter was at a much greater distance

The University of Oxford has sanctioned the extension of the university observatory to provide a home for two Milne-Shaw pendulums, and a bequest of £1,000 from the late Professor John Milne, one of the chief founders of seismology, has been put in a trust fund, the income to be at the disposal of the chairman for the time being of the seismological committee of the British Association.

THE NATIONAL ARBORETUM

Plans for the establishment of the National Arboretum, authorized by the last congress, have been discussed, according to *The Museum News*, at informal meetings of the newly appointed advisory council. With the probability that an appropriation for the purchase of land will be passed at the next session, along with the deficiency bill, of which it forms a part, various phases of the project are now receiving consideration

The Department of Agriculture has estimated that about a year will be necessary, in which to acquire land, before the actual laying out of the grounds can begin In the plans already discussed, emphasis has been laid upon the research features, which are to be somewhat subordinated to recreational aspects

The site, which has been tentatively selected, lies upon the Anacostia River, within four miles of the center of Washington Part of the land is now under government ownership, and is being reclaimed from its original swamp condition The location of the arboretum at this point means that eventually it will lie along or near the proposed new parkway entrance to the city A new boulevard, which will connect Washington with the northern and eastern cities will, at some future time, be opened up along the Anacostia valley, in which the arboretum site is also located

It is pointed out by officials of the Department of Agriculture that the selection of Washington for the site of an arboretum will secure an average climatic condition about midway between that of the extreme northern states and those along the southern border They also predict that there will be very close cooperation between the various institutional herbaria, city and state botanical gardens and the various propagating stations operated by the federal government in California, Florida, Georgia, Maryland and other states The work of introducing foreign plants will be greatly facilitated thereby and the agricultural explorations of the government will also assist in the building up of the herbarium.

BIOLOGY AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

The trustees of the California Institute of Technology have voted to establish a department of biology and to erect at once biological laboratories, so that the institute may, in the autumn of 1928, initiate major lines of research and offer courses of study, both graduate and undergraduate, in that science. Professor Thomas H. Morgan, now professor of experimental zoology at Columbia University, has accepted the position of chairman of the new divi-

sion of biology, and will organize its various branches. Ample funds have been provided for the endowment, construction and equipment of the laboratories by members of the Board of Trustees of the institute and by the General Education Board

As in the existing departments of the institute, emphasis will be placed primarily on research and graduate study, and, even in these directions, no attempt will be made to cover at once the whole science of biology, but rather, efforts will be concentrated on the development of those of its branches which seem to offer the greatest promise as fields of research. As rapidly as leaders can be found, it is proposed to organize groups of investigators in general physiology, genetics, biophysics, biochemistry, developmental mechanics, and perhaps later experimental psychology The choice of these fields of modern research implies that emphasis will be laid on the intimate relations of biology to the physical sciences That a closer association of these sciences with biology is imperative is becoming more and more apparent as indicated by the development of special institutes for such work In England, Germany, Russia, Scandinavia and France research institutes, specializing in different biological fields, yet primarily concerned with the applications of mathematical, physical and chemical methods to biological subjects, have developed in recent years The latest example is a gift of thirty million francs to the Paris Academy of Sciences to organize an Institute of Physico-Chemical Biology, for the purpose of studying "the physico-chemical mechanism of the phenomena of life"

The California Institute is undertaking this development of biological research by the application of physical and chemical methods not only because of its intrinsic importance, but also because the close association with the strong research departments of physics and physical chemistry of the institute can not fail to contribute greatly to its success Most physiological laboratories have in the past, for practical reasons, been associated with medical schools, and few of them have been in intimate contact with the research staffs and had the use of the research facilities of laboratories which are primarily devoted to fundamental investigations in the physical sciences

For the study of biology the institute will in 1928 and thereafter make the following provision It will introduce into its four-year undergraduate course in science, which in its last two years now has options in physics, chemistry, mathematics and geology, a new option in biology. This option will include those fundamental biological subjects that are an essential preparation for work in any special field of pure or applied biology, and the four-year course as a whole will in addition afford a far more thorough training in the basic sciences of physics, chemistry and mathematics than students of biology, medicine or agriculture commonly receive. This undergraduate course will be supplemented by a fifth-year course, leading to the degree of master of science in biology, in which students may specialize in study and research in various branches of the science Special opportunities will also be offered for the pursuit of more advanced courses and extended researches leading to the degree of doctor of philosophy, to students desiring to become college teachers, research men, or professional experts

SCIENTIFIC NOTES AND NEWS

Sir Charles Scott Sherrington, O M, professor of physiology at the University of Oxford, will give three lectures under the Edward K Dunham Lectureship for the Promotion of Medical Research in the Amphitheater of the Harvard Medical School at five o'clock on Monday, October 10, on "Observations on Stretch Reflexes"; Thursday, October 13, on "Modes of Interaction between Reflexes," and Monday, October 17, on "Some Factors of Coordination in Muscular Acts"

The faculty of the Medical School of the University of Wisconsin gave a dinner recently at the Maple Bluff Country Club in honor of Dr Aristides Agramonte, professor of bacteriology, University of Havana, and Dr Salanos Ramos, dean of the medical school of that university, which was attended by about sixty-four physicians, President Glenn Frank, of the University of Wisconsin, and members of several faculties Dr Charles R. Bardeen, dean and professor of anatomy, was toastmaster, Dr Frank welcomed the visitors, who are on a tour of inspection of medical schools, and Dr Agramonte spoke of health work in Cuba and the development of the medical school of the University of Havana, which was founded in 1728

Professor H. E Armstrong, the distinguished British chemist, and Mrs. Armstrong celebrated their golden wedding on August 30, on which occasion there was presented to them a portrait of Professor Armstrong by T. C Dugdale. At the same time there was presented an illuminated album, signed by a large number of workers in chemical science

F. C. Elford, of the U. S Department of Agriculture, has been elected president of the World's Poultry Congress, the fourth meeting of which will be held in England in 1930.

Dr. Karl Siek, professor of surgery in the University of Hamburg, has been appointed honorary

professor by the University of Göttingen in recognition of his services in organizing medical education in Turkey.

Dr. Guy W Clark, since 1919 assistant professor of pharmacology in the University of California Medical School at Berkeley, has resigned to become director of the pharmaceutical department of the Lederle Antitoxin Laboratories

Frank C Whitmore, head of the department of chemistry at Northwestern University, is on sabbatical leave to serve in Washington as chairman of the Division of Chemistry and Chemical Technology of the National Research Council.

In the absence from this country of Dr C E McClung, professor of zoology in the University of Pennsylvania, managing editor of *The Journal of Morphology and Physiology,* contributors are requested to send their manuscripts directly to the Wistar Institute, 36th Street and Woodland Avenue, Philadelphia, Pa Dr. McClung expects to spend some months at the Naples Station.

Dr. Chas L Swisher, professor of physics at the North Dakota State College, has been granted a leave of absence by that institution in order to permit him to accept an assistant professorship in physics at Yale University for the coming year.

Dr. Fred F. McKenzie, instructor and assistant in animal husbandry in the Experiment Station of the University of Missouri, has resigned to accept a position as director of the College of Agriculture at the International College, Smyrna, Turkey.

Philip L Riley, instructor in the department of biology and public health at Massachusetts Institute of Technology, has been appointed director of health education in the public schools of Cleveland, Ohio

Frederick H Rawson has been elected a member of the board of trustees of the Field Columbian Museum Mr. Rawson, who is chairman of the board of directors of the Union Trust Company of Chicago, has been actively interested in the work of the museum for years as life member, corporate member and patron.

The Committee on Scientific Research of the American Medical Association has recently voted to Dr. Edward Reynolds and Dr Earnest A Hooton, of Harvard University, a grant of $1,000 for a research on the mechanism of the erect posture by X-ray study of the living in the erect position

Dr. R Hugershoff, of Dresden, gave on September 16 an illustrated lecture and demonstration on the "Aerocartograph," a new process of making contour maps from aerial photographs, before members of the U. S. Geological Survey and other federal mapping agencies.

Dr. Joseph Jastrow, formerly professor of psychology in the University of Wisconsin, will this autumn give a series of lectures on "The Psychology of the Emotions," under the joint auspices of the New School for Social Research and the Child Study Association of America.

Miss Ida M Mellen, assistant to the director of the New York City Aquarium, will broadcast a series of seventeen talks from WNYC, beginning with a talk on "The New York Aquarium and its Denizens," on November 6, at 9 p m Eleven talks on fishes will follow, other subjects being whales, seals, sea birds, alligators and turtles

Professor Geo. T Hargitt has presented to the library of the Marine Biological Laboratory that part of the late Charles W. Hargitt's library that contains the literature on Coelenterates. The gift comprises a collection of the literature of the group that could be gathered together in no way so completely as that of selection by such a specialist as Dr Hargitt. A memorial tablet will be placed on the wall of the library stack-rooms to commemorate Dr Hargitt's life and work and his connection with the laboratory The libraries of Glendower Evans, C O. Whitman, Edward G Gardiner and many others have also in part, or in whole, been deposited in the library.

At the Leeds meeting of the British Association it was announced that the council was supporting a movement to purchase Charles Darwin's home and estate at Downe

It is proposed by Germans resident in Brazil to erect a memorial to the naturalist Fritz Müller in Blumenau, where he spent the greater part of his life.

The municipal council of Paris has approved the erection of a statue to the physician and physiologist Vulpian, whose researches on the nerves and vasomotor phenomena are well known The statue, the work of the sculptor Paul Richer, member of the institute, will be placed near the Faculté de médecine.

The death is announced on January 14 of Sarah Frances Whiting, from 1876 to 1912 professor of physics and physical astronomy and from 1904 to 1916 director of the Whitin Observatory, becoming on her retirement director emeritus. Miss Whiting was eighty-one years old.

Frank Clinton Wright, editor of *The Engineering News Record,* died on September 18, aged forty-six years.

DR. MABEL M. BROWN, assistant professor of botany in the University of New Hampshire, died on September 16.

HENRY RICHARDSON PROCTER, professor at the University of Leeds and later honorary director of the research laboratory for the leather industry established in that university, died on August 17 at the age of seventy-nine years.

PROFESSOR C. PULLFRICH, of the Zeiss Optical Works at Jena, known for his investigations in optics, has died at the age of sixty-nine years.

As has been noted in SCIENCE, the fall meeting of the National Academy of Sciences will be held at Urbana, Illinois, at the University of Illinois, beginning on Tuesday, October 18 This is a departure from the usual custom of holding the meeting in November and beginning on Monday. Dr A L. Day, of the Geophysical Laboratory of the Carnegie Institution, will give an illustrated evening lecture on October 18 on "The Volcano Problem." The executive committee of the American Association for the Advancement of Science is to hold its October meeting in Urbana on October 16 The state geologists of the country are to assemble in Urbana on October 20 for a three days' field trip under the direction of the geologists of Illinois.

THE fifty-sixth annual meeting of the American Public Health Association will be held, under the presidency of Dr. Charles V Chapin, at Hotel Gibson, Cincinnati, Ohio, from October 17 to 21.

THE American Society of Tropical Medicine will hold its twenty-third annual meeting in Boston, from October 21 to 22, under the presidency of Dr. George C. Shattuck, assistant professor of tropical medicine, Harvard University Medical School, Boston.

THE twenty-first annual convention of the Illuminating Engineering Society will be held in the Edgewater Beach Hotel, Chicago, from the eleventh to the fourteenth of October.

THE fourteenth annual meeting of the New England Section of the American Society of Agronomy will be held at Boston on December 2 and 3. Symposia on "Land Utilization Programs and Fertilizer Requirements of Specific Crops" will be held.

THE U. S Civil Service Commission announces an examination for the position of technical editor for vacancies in the forest service at Washington and at the Forest Products Laboratory at Madison, Wis The entrance salary is $3,800 a year.

THE *Journal* of the American Medical Association states that the state department has advised the U. S. Public Health Service that the Egyptian legation in Washington desires brought to the attention of qualified American citizens the fact that the Egyptian government wants to employ a foreign specialist in medical entomology in the ancylostoma and bilharzia research section of the public health laboratories of the Egyptian government.

UNIVERSITY AND EDUCATIONAL NOTES

THE General Assembly of Georgia just adjourned appropriated $1,000,000 per year for each of the years 1928 and 1929 to be used to equalize educational opportunities. This revenue is to be derived from a one half cent tax on each gallon of gasoline and a tax of one cent on each gallon of kerosene If the revenue from these two taxes does not yield a million dollars the balance will be supplied out of the general treasury. All revenue from these two taxes will be used as an equalization fund, even though it should exceed one million dollars.

ISAAC E EMERSON, chairman of the board of the Emerson Drug Company, has given two fellowships to the University of Maryland. One is for a professorship in biological testing yielding $4,000 annually; the other, yielding $1,500, is to maintain a fellow in pharmacology in the School of Medicine

SIR EDWARD BROTHERTON, the chemical manufacturer, of Leeds, who has works in Leeds, Liverpool and other parts of the country, has made a gift of £100,000 for a new library for Leeds University

DR. S W RANSON, professor of neuroanatomy at Washington University, St Louis, has been appointed professor of neurology and director of a Neurological Research Institute at Northwestern University Medical School. Quarters for the new institute have been provided in the Ward Memorial Building, which was erected last year on the McKinlock campus. The institute will be devoted entirely to research and will conduct investigations in the anatomy, physiology and pathology of the nervous system and in clinical neurology and neurosurgery Dr Lewis J Pollock, professor of neurology, and Dr. Loyal E Davis, associate professor of surgery, will cooperate with Dr Ranson. An assistant professor of neuropathology and an assistant professor of anatomical neurology as well as younger men with training in physiology and biochemistry will be appointed. Problems connected with the innervation and nervous control of the skeletal muscles will be among the first with which the institute will deal.

DR. J. C. HUBBARD, head of the department of physics at New York University, has been appointed professor of physics at the Johns Hopkins University.

Dr. William Mansfield Clark, Ph.D., of the Hygienic Laboratory of the U. S. Public Health Service, Washington, has accepted the position of professor of physiological chemistry at the Johns Hopkins University School of Medicine.

Quentin D. Singewald, Ph.D. (Johns Hopkins, '26), has been appointed to an assistant professorship of petrography in the Colorado School of Mines, at Golden.

Dr. Peter Debye, professor of physics in the Technical School of Zurich, has accepted a call to the University of Leipzig, where he will succeed Professor Otto Wiener.

DISCUSSION AND CORRESPONDENCE

AN ECHO FROM MORRISON CHAPEL, TRANSYLVANIA UNIVERSITY

The description of the echoes from the Lincoln Memorial by C. A. Browne in Science, July 29, 1927, calls to mind an interesting echo produced by Morrison Chapel of Transylvania University. The sound comes from the bell of the Court House clock, several blocks away. The echo was first noticed one evening several weeks ago when the writer was sitting in a park adjacent to Transylvania campus. It so happened that the position taken was such that the echo gave the impression of the clock striking twice as rapidly as usual, and, of course, a double number of strokes. The echo seemed slightly higher pitched than the clock bell. This first position is indicated as point A. Subsequent observations from various points in the park and campus are as follows. From points B, C and D the echo follows the bell so closely as to sound like a double stroke rather than a double number of strokes, and at E and F the echo was not heard.

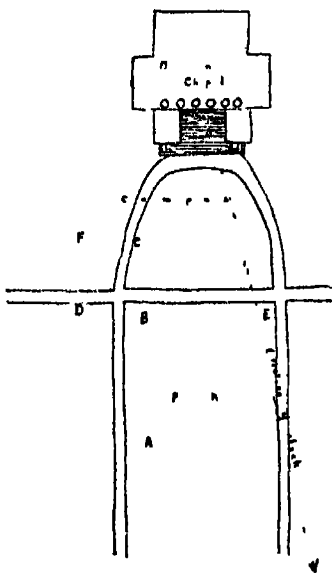

Fig. 1

William A. Anderson, Jr.

Kentucky Agricultural Experiment Station, Lexington

ICARUS AND MELTING WAX

In Professor Eddington's fascinating book "The Internal Constitution of the Stars," we are given the privilege of watching the "hurly-burly of atoms, electrons and ether-waves" in stellar interiors. Our astronomer pictures the commotion prevailing in these tremendous gas-houses, as atoms go whizzing by, now and then shedding an electron and anon grabbing some stray one, the whole result of the bustle being the emission of ether-waves. No humble earthworm can say aught to the contrary, but he may balk in following the astronomer in flights through the earth's atmosphere.

"In ancient days," he says, "two aviators procured to themselves wings. Daedalus flew safely through the middle air and was duly honored on landing. Icarus soared upward to the sun till the wax melted which bound his wings and his flight ended in fiasco.

The classical authorities tell us that he was only doing a stunt, but I prefer to think of him as the man who brought to light a serious constructional defect in the flying machines of his day."

These pioneer airmen were father and son. And the question naturally arises "Was not father in equally great danger?" His wax attachments were exposed to the full radiation from the earth. Icarus, poor boy, flying higher and higher had to go through the troposphere. And as he rose from earth it got colder and colder. Even in a genial clime on a midsummer day, by the time he was five miles high, he would have been frozen stuff. With a temperature of $-40°$ C the very mercury in his thermometer would have solidified. If he lived to reach the stratosphere he still had to fly a hundred miles in cold storage!

And why decry old Daedalus? If it was necessary to find the melting-point of wax, the experiment could have been carried on just as well down below.

My good friend Dr. W. W. Campbell used to say "This would be a happy world for astronomers if only there were no atmosphere!"

Alexander McAdie

Blue Hill Observatory

HORTUS GRAMINEUS WOBURNENSIS

The undersigned would like to be advised of the location of an 1816 edition of George Sinclair's Hortus Gramineus Woburnensis. The copy in the Library of the United States Department of Agriculture gives on page 108 a description of *Trifolium medium*, a red perennial clover, and the author states that to avoid any chance of mistake he presents a specimen of

the red perennial clover, and on page 109 a dried specimen of *Trifolium pratense* is presented. The undersigned has been unable to locate any other copy of the 1816 edition and wishes to do so in order to ascertain whether this error is found in all copies or is peculiar to this one copy and will appreciate any information as to libraries where other copies may be consulted.

A. J Pieters

Bureau of Plant Industry

QUOTATIONS

THE WORLD POULTRY CONGRESS

Although from a spectacular standpoint the recent Poultry Congress at Ottawa was an unqualified success, in consequence of which the poultry industry in Canada will derive considerable benefit, it is difficult at present to form an estimate of the educational value of the proceedings and to assess the importance of the information derived from the numerous papers and discussions There would appear to be some justification for critical comment upon the fact that papers were not printed in advance, so that, as five sections were in session at the same time in different halls, delegates experienced great difficulty in gaining more than a vague impression of the whole, while the general public must await the publication of the official proceedings before it will be possible to summarize the educational effect of the congress

The general impression, which is confirmed by the evidence of delegates, is that insufficient time was available to do justice to the many papers presented by authorities in the numerous branches of the industry Not only did the "five-ring circus," as an American delegate described it, create confusion among those who were desirous of getting full educational value, but the absence of printed papers and the short time allowed for each paper necessarily limited the scope and the value of such discussion as was permitted. In view of the fact that the next congress is to be held in England in 1930 it will be necessary to formulate a policy that will do justice to the educational side, though it may be impossible to emulate the generous manner in which the Canadian government gave the poultry industry the best publicity it has ever enjoyed. The fortunate circumstance which enabled the Prince of Wales and Mr Baldwin to visit the congress set the seal upon the efforts of the Canadian authorities to make the event a thorough success in the spectacular sense

It is the more regrettable, therefore, that doubt exists as to whether the original purpose of world's poultry congresses was sufficiently considered. The International Association of Poultry Investigators and Instructors inaugurated these triennial congresses with a view to enabling research workers and educationists to express their views and discuss experiences, and one suspects that interest in the Canadian congress spread so widely that the authorities found themselves with a plethora of good things which could only be embraced in the program by the quintuple-session plan. Even that would have been effective had the papers been printed in readiness for the proceedings, and it seems essential that that precaution should be taken at future congresses unless a drastic measure of compression is adopted by limiting the number of papers

A further point which must be borne in mind for future congresses arises from apparent differences between investigators and practical poultrymen It is conceivable that some of the former approach the task of research from the laboratory standpoint, whereas some practical men are so exacting as to demand that all investigation shall begin and end in the poultry yard Doubtless there is a measure of reason on both sides, and a considerable amount of latitude must be allowed It can not be denied, however, that research is a means to practical progress, and in connection with poultry-keeping its success must be measured by what it achieves in smoothing the path of the practical worker That in turn depends upon close association and mutual confidence between the two classes, so that every effort should be made to interest scientific investigators in the every-day problems of the practical poultrymen at the same time as the latter are induced to take research workers into their confidence —*The London Times*

SCIENTIFIC BOOKS

Elements of Physical Biology By Alfred J Lotka. Baltimore, Williams and Wilkins Co, 1925 xxx + pp. 460

Once in a while some one writes a really new book such as "The Fitness of the Environment," "Winnie the Pooh," "Die Ausdehnungslehre" or "Oedipus Tyrannus." Sometimes such works are immediately approved like the first two, sometimes, as was the case with the third, not even the brightest minds of the time seem to appreciate the significance of the book and a generation or two elapses before the author comes into his own. With respect to the last, it was crowned at once with approval but perhaps not understood until the advent of psychoanalysis millenniums later, although to one who knows his Greek drama not quite so poorly as his psychoanalysis it sometimes seems as though the complex that afflicted Oedipus was the opposite of the Oedipus complex! Lotka's "Physical Biology" is a new, not merely a

recent, book, whether it will go promptly with our effective scientific literature may be doubted, it is not easily read by most biologists who, rather than mathematicians or physicists, must make it effective. Like many really new works it contains a great deal of the author's thinking and writing for a good many years The fundamental idea is simple, namely, that the rates of change of certain variables x_1, x_2, . . . x_n are functions of the variables themselves and of certain parameters P_1, P_2, . . . P_m, that there will be an equilibrium situation (with respect to the time) for those values of the variables which make the *rates of change zero*, albeit this equilibrium situation may change with changing values of the parameters, and that if the variables differ only slightly from their equilibrium values there will occur a variation of those variables in time Primarily it is the study of this well-known system of equations that concerns the author and the interpretation of the results when the variables and parameters represent quantities of biological significance.

The simplest case is the law of population growth, $dX/dt = F(X)$, it being assumed that the rate of that growth depends solely on the population. Here there will be equilibrium for those values of X which make $F(X) = 0$, *i e*, the population can maintain itself at any value X_0 such that $F(X_0) = 0$ because then $dX/dt = 0$ and there is no rate of change of population. One solution is $X_0 = 0$. If X is near zero we may expand $F(X)$ by Maclaurin's series to a single term and have $dX/dt = aX$, which gives the Malthusian law of growth Evidently, too, the population may be saturated at a value X_0 different from zero. In the neighborhood of this value we may expand by Taylor's series to find $dX/dt = a(X-X_0)$, where for stability a is necessarily negative, and asymptotic approach to the equilibrium value from above or from below If we consider the two roots 0 and X_0 we may write $dX/dt = aX(X_0 - X)\varphi(X)$, and by neglecting φ (X), *i e*, by assuming it does not vary appreciably between 0 and X_0, we have the Verhulst-Pearl-Reed law of population growth—a law *which* the author shows *does not hold for* the growth of the rate in weight (Donaldson). By considering two variables in a similar manner one may discuss the interrelation of two populations, symbiosis, immunizing diseases, malaria-like diseases, parasitism, etc. Or by the further analysis of the growth function of a single variable one may derive certain demographic relations and conceptions which have been introduced by the author and used by him as a means of research on human populations.

From this brief discussion I intend to imply what I believe to be a characteristic of the book, namely, that it is fundamentally mathematical rather than physical biology, that it portrays the workings of a mind more mathematical than physical. Certainly physical biology should include a great deal about the theory of dimensions, about surface tension, etc., indeed much of the point of view and of the sort of material which may be found in d'Arcy Thompson's "Growth and Form." There seems to be in the book almost none of the sort of thinking that a physicist does. I do not particularly object to the author's choice of a name for his book, it is all right if you understand it; I am merely trying to point out that what some might expect to find under the name is conspicuous by its absence. Gibbs did not call his great work physical chemistry, and if he had, a contemporaneous reviewer might have made observations not dissimilar to mine above. And, by the way, although Lotka undoubtedly knows his Gibbs, even the "Statistical Mechanics," and often gives a type of reasoning very familiar to students of Gibbs, there happens to be no mention of that great name in the Index of Names which appears to list more than 400 persons as cited in the text. And again, by the way, if one will look at that list of names and examine the text to see how intimately ideas from very many of them are interwoven to carry forward the author's own thought, one can not but realize the long time and deep study and varied reading required to bring oneself to a position where he could contemplate writing such a book

Although the main underlying thought may be mathematical, there is much general philosophy of science and much general descriptive material to be found in this work, much that is as easy to read as it is interesting and instructive, not a little perhaps which is of no great importance to the work as a whole. The author knows how to write, not only in detail but in a broad way, how to lighten heavy reading with description, to intersperse chapters weighty in mathematical formulas with those entirely free of them. And what a mass and variety of material he has thus put together! It would be quite out of the question for a single reviewer either to do it justice or to point out whatever defects of judgment it may contain.

EDWIN B. WILSON

SPECIAL ARTICLES

THE ANTI-COAGULATING ACTION OF THE SECRETION OF THE BUCCAL GLANDS OF THE LAMPREYS (PETROMYZON, LAMPETRA AND ENTOSPHENUS)

THE function of the paired buccal glands in the lampreys has for a long time been a puzzle to zoolo-

gists. There is no sign of them present in the larval or ammocoetes stage; and they appear as wholly new structures on transformation. Their ducts open in the floor of the sucking mouth near the rasping tongue (fig. 1).

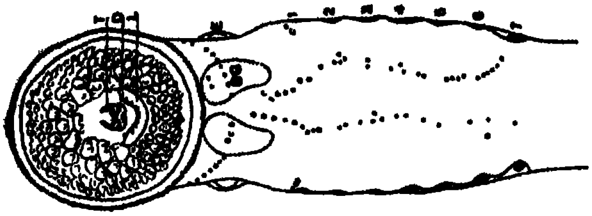

FIG. 1 Ventral view of the head and branchial region of a Lake Lamprey to show the position of the buccal glands and the opening of their ducts. BG The bean-shaped, buccal glands at the level of the eyes (E). T The rasping tongue D. The duct-opening of the left buccal gland L The infraoral lamina. 1, 2, 3, 4, 5, 6, 7 The seven branchiopores or gill openings on the left side

The wall of the sac-like gland is considerably folded and lined by a glandular epithelium. It is thus a combined secreting organ and a reservoir. Furthermore, for about three fourths of its circumference it has a special constricting capsule of striated muscle In this respect it resembles the poison glands of snakes.

From the relation of the glands with the mouth, they are frequently spoken of as salivary glands, but their structure is not at all like ordinary salivary glands, and no proof has ever been given that the secretion has any digestive action

At the only stage when these glands are present, the food of the lampreys is proteid in character, and consists almost wholly of blood from the fishes they prey upon, as one can see by examining the intestinal contents. Occasionally one may find traces of muscle or of other tissues torn (fig 2) from its victim by the rasping tongue, but the main mass of the food as found by our many examinations has always been blood.

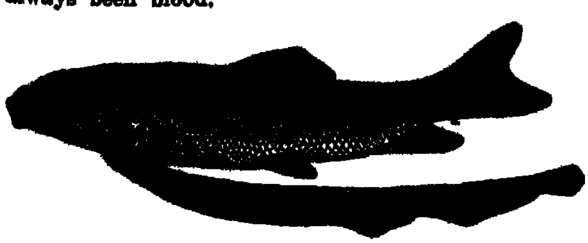

FIG. 2. Lake Lamprey attached to a fish. Above the pectoral and ventral fins are scars showing where other lampreys had made ragged openings with their rasping tongues.

In studying the structural arrangements of the lampreys for taking food it will be seen that the opening of the oesophagus is relatively small, and in Lampetra and Entosphenus especially, it is covered by a kind of grating That is, the anatomical arrangement is adapted to the ingestion of liquid food. It is well known that the blood of fishes when it leaves the blood-vessels and comes in contact with the wounded tissues, clots very quickly. This is of course of great advantage to animals living in water, but it has two great disadvantages for the lampreys: It would not be so easy to swallow the clots as the liquid blood on the one hand, and on the other the clotting would tend to close the openings in the torn blood vessels and thus shut off the supply of food for the lamprey.

With this knowledge in mind, and remembering that the leech and the vampire bat have a secretion which they pour into the wounds they make in animals to prevent the blood from coagulating, it occurred to us that the lamprey's buccal-gland secretion might serve the same purpose

Fortunately, by the aid of friends, a lake lamprey with the intestine full of blood was obtained, also some brook lampreys (Lampetra) early in the breeding season, and some of the secretion from the Pacific Coast lamprey (Entosphenus). Finally, by personal effort, many examples of the lake lamprey were caught when spawning. In all cases the secretion was obtained by aspirating it from the sac-like glands with a hypodermic syringe.

To test the hypothesis, the buccal-gland secretion of the lake lamprey was mixed with the blood of a bony fish (Amiurus), such as the lamprey often feeds upon. It entirely prevented the coagulation of the blood if in sufficient quantity. If the relative amount of blood was too great, the coagulation was delayed, but the fibrin filaments appeared in the end. In all cases the gland secretion tended to distort the red corpuscles and to haemolyze them. If the secretion was in excessive amount it extracted the haemoglobin very quickly, and in some cases seemed to destroy the corpuscles entirely, leaving only a granular mass. If the blood from the heart was put directly into the gland secretion, clotting did not occur and the corpuscles settled, leaving a straw-colored serum on top. Furthermore, when the buccal-gland secretion of a lamprey was mixed with its own blood, coagulation was prevented.

The buccal-gland secretion of all the lampreys when mixed with human blood delayed or prevented the coagulation. If a sufficient amount were used,

no fibrin ever appeared, but if a smaller relative amount were used the clotting was delayed, but the fibrin filaments finally appeared, thus resembling the action on fish blood

For all of the experiments, the dark-field microscope was used In this way the minutest amount of fibrin could be detected. The action was tested upon human blood from many different racial stocks —English, Norwegian, Dutch, Hebrew, etc The action was uniform in all cases

There was one striking difference between the action of the buccal-gland secretion of the lake lamprey (Petromyzon marinus unicolor) and that from Lampetra and Entosphenus With the lake-lamprey secretion the human red corpuscles were prevented from forming rouleaux, but with the secretion from Lampetra and Entosphenus, the red corpuscles did form rouleaux although the fibrin formation was prevented as with the lake-lamprey secretion In this respect, the Lampetra and Entosphenus secretion resembled the action of the sample of hirudin from the leech with which we experimented

It is hoped that a full account of the development and structure of this interesting organ and the action of its secretion can be published with full illustrations in the near future

SIMON H. GAGE
MARY GAGE-DAY

CORNELL UNIVERSITY

EQUATION OF ELECTRONIC CONDUCTION IN UNI-POLAR NON-METALLIC FILMS

THE equation for variation of current flowing through a uni-polar non-metallic film due to electronic conduction when the film is in intimate contact with a metal can be derived by the use of Poisson's potential equation, in a manner similar to the method used by Langmuir (*Phys Rev.* 1913, II, p 453, *Gen Elec Rev* 1915, p 330) in studying the effect of the space charge on the emission of electrons from hot filaments

In the simple case of an infinite plane emitting surface and an infinite parallel conducting plane, we have from Poisson's equation

$$\frac{d^2 E}{dx^2} = -4\pi\varrho \qquad (1)$$

where E is the potential due to the space charge at point x along a line perpendicular to the planes, and ϱ is the volume density of the space charge Consider a current flowing from the metal through the film in such intimate contact that electrons emitted from the surface of the metal penetrate into the film If the concentration of free electric carriers in the non-metallic film is normally so small that it can be neglected, then at the boundary between metal and film we can then write $E=0$, so that, neglecting any initial velocity of electrons emitted from the surface of the metal, we can write for the kinetic energy,

$$\frac{1}{2} m V^2 = Ee \qquad (2)$$

where m is the mass of an electron, e is its charge, and V is its velocity under the point potential, E. The current, I, flowing through the film can be written as

$$I = V\varrho A \qquad (3)$$

where A is the area of the film Eliminating V in these equations and substituting in Poisson's equation to eliminate ϱ we obtain

$$\frac{d^2 E}{dx^2} = \frac{4\pi I}{A}\sqrt{\frac{m}{2Ee}} \qquad (4)$$

the space charge, ϱ, being taken as negative on account of the negative charge of the electron Integrating this equation subject to $\frac{dE}{dx}=0$ when $E=0$ gives

$$\left(\frac{dE}{dx}\right)^2 = \frac{8\pi I}{A}\sqrt{\frac{2mE}{e}} \qquad (5)$$

Integrating a second time, and solving for the current, we have finally,

$$I = \frac{A}{9\pi}\sqrt{\frac{2e}{m}}\,\frac{E^{3/2}}{x^2} \qquad (6)$$

Considering the flow of current in the opposite direction, *i.e.*, from film to metal with which it is in intimate relation, the emission of electrons from the film contact electrode is very feeble; first, because the two are not in intimate relation, and second, because of its reluctance to part with electrons In this case the same form of equation as given in (6) will hold.

Insufficient data are available to verify the coefficients of equation (6). Furthermore equation (2) holds only for film thicknesses less than the mean free path of the electron so that collisions do not affect the velocity of the electron. It is therefore best to write the equation in the form

$$I = kE^{3/2} \qquad (7)$$

for given dimensions of the film and for a given temperature The constant, k, may then be determined empirically.

The form of equation (7) may be tested from data obtained experimentally by Grondahl (*Jour. A. I. E E.*, March, 1927, p. 216), who has made measurements on the current flowing in both directions through a copper oxide film on a copper disk. The observed values of I_1 and I_2 are compared with

those calculated from equation (7) when $k_1 = 1.79$ and $k_2 = .00017$.

	Observed		Calculated	
E	I_1	I_2	I_1	I_2
0	0	0	0	0
0 5	0 7	.0001	0 64	.000063
1 0	1 8	.0002	1.79	00017
2 0	5 2	.0005	5 06	00048
3.0	9 0	.0008	9.30	00088
4.0	14 0	0012	14.3	00136

The agreement is about as good as can be expected on account of the error in reading the observed values of the current from a small scale curve

The derivation of these equations have been based upon the theory of this phenomenon suggested by Grondahl (SCIENCE, Sept. 24, 1926, p 306).

FRANK M GENTRY

THE NEW YORK EDISON CO,
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THE AMERICAN CHEMICAL SOCIETY

MEETING OF THE COUNCIL

THE Council of the American Chemical Society, President George D Rosengarten presiding, and with 120 councilors in attendance, met at Detroit on the afternoon of September 5

The section of history of chemistry having held successfully the six meetings prescribed by the council petitioned that it be made a division of the society and this request was granted and the by-laws submitted approved. New by-laws presented by the division of chemistry of medicinal products were also approved A proposal that a section of chemical economics should be organized was discussed and without formal vote referred to the division of industrial and engineering chemistry, under the auspices of which symposia will be held to determine interest in the subject.

A B. Lamb, of Harvard University, was reelected editor of the *Journal* of the society, and associate editors Roger Adams, of the University of Illinois, and E W. Washburn, chief chemist of the Bureau of Standards, Washington, D. C., were reelected members of his board. E J. Crane, Ohio State University, was reelected editor of *Chemical Abstracts*, and H. E. Howe, of Washington, editor of *Industrial and Engineering Chemistry* W. A Noyes, of Urbana, Ill., was reelected editor of the *Scientific Series of Monographs*, and H. E Howe, editor of the *Technologic Series*. F. A. Lidbury, of Niagara Falls, N. Y., A. D Little, Cambridge, Mass, and C. E K. Mees, of Rochester, N. Y., were reelected to the technologic monograph board. H. S. Taylor, of Princeton, and W. A. Patrick, of Johns Hopkins University, were elected as society representatives on the editorial board of the *Journal of Physical Chemistry* William McPherson, of Ohio State University, was reelected a member of the society's executive committee.

The president of the society having been asked to lend his name to the national committee being organized to secure the financial participation of the United States in the erection of a Maison de la Chimie in Paris in commemoration of the centenary of the birth of Marcelin Berthelot in which memorial building is intended to house the international office of chemistry the formation of which is to be undertaken through diplomatic channels next May, the president called upon the secretary to read the papers in the matter and to give the history of recent movements looking toward the creation in one of the capitals of Europe of international control of chemistry Following the complete statement which included the request of the president for advice from the society's executive committee, the following was presented for the council's action

President George D Rosengarten, of the American Chemical Society, having asked counsel of his advisers regarding a communication from M Maurice Leon, vice-chairman of the "American Organization Committee for American Participation in a Maison de la Chimie" requesting the use of his name as a member of the committee, the executive committee of the Society unanimously advise him to decline for the reason that his acceptance would tacitly commit the American Chemical Society to a project it can not approve

The American Chemical Society is glad to honor the name and accomplishments of Marcelin Berthelot and in evidence thereof has appointed two of its own past presidents to represent it at the centenary celebration on October 25, 1927 An international "Maison de la Chimie" and "An International Office of Chemistry" nationally conceived with predetermined control and location in Paris is an entirely different matter to which the American Chemical Society can not give its adherence, even though it has been connected with so eminent a name as Berthelot to insure its success

The American Chemical Society has naught but good wishes for the "Chemists' Club" of New York, the long considered "House of Chemistry" of Great Britain, the "Hofmann House" of Berlin, or for a national "Maison de la Chimie" to be located in Paris and would be glad to see any of its members, who are so inclined, contribute to their support It can not, however, admit the propriety of any national group assuming the right to centralization of control of international chemistry within its own territory and sphere of influence, even if the major costs of construction and upkeep of such an institution were not assessed upon the rest of the world.

The American Chemical Society believes that if an International Office of Chemistry, having as its object

the centralization of influence of chemical science, both pure and applied, is ever deemed desirable or necessary, it should be inspired through cooperative action of the world's scientific chemical organizations and not by governments through political channels.

The American Chemical Society does not approve any world centralization of control of chemistry and believes that the future progress of chemistry can best be served as heretofore by harmonious cooperation of national organizations

The society specifically disclaims any discourtesy to the organizers of the present movement, but believes the underlying principle to be so detrimental to continued international cooperation that it would be lacking in probity if it did not make its judgment known

After a few questions it was moved and carried that the council approve the advice given by the executive committee The motion was then carried, without dissenting vote, that the secretary be directed to inform those government officials before whom the question of the office of international chemistry might come of the society's position

The report of Dean Wendt, director of the first session of the Institute of Chemistry of the American Chemical Society, was presented and accepted with thanks to all those who had been active in furthering the interests of the institute

At the Richmond meeting it was requested that a by-law be framed regarding the Endowment Fund and the following By-law No. 22 was adopted The Endowment Fund of the society shall, Article 4, Sec 2, of the Constitution of the Society, be collected and administered in two parts (1) A permanent fund, the income of which alone may be expended only to help meet the society's constantly growing need for funds to record the results of chemical research in its publications, and (2) a revolving fund limited to $100,000 to insure the publication of successive decennial indices to *Chemical Abstracts*, the sales of which shall be credited to the fund until the $100,000 has been reached or replenished Any excess above $100,000 in the Revolving Fund at the end of any fiscal year may be used for the same purposes as the income of the permanent fund.

The report of the executive committee made by direction of the council at the Richmond meeting concerning a proposal that an Institute for Chemical Education be established was presented and referred to the society's committee of chemical education. The report in part follows At the Richmond meeting the council referred to the executive committee for consideration and report the recommendation of the committee on chemical education that there be approved an Institute of Chemical Education Although the resolution specifies that in all financial details such an institute shall be subject to final approval by the directors and in other matter to the approval of the executive committee or the council, the committee feels that as referred to it details concerning such an institute are as yet too nebulous to enable intelligent action to be taken. While it is understood that the discussion of such a research institute, both in the senate of chemical education and in the committee on chemical education, centered around the tentative plan published in the *Journal of Chemical Education* in January, 1927, it has been stated in conversation by several members both of the senate and of the committee that there is a lack of agreement with respect to the plan published However, resulting discussion has brought forward several points worthy of further consideration

Therefore, while the executive committee feels that the matter is not in a form sufficiently definite to enable it to give either a negative or an affirmative answer, it has seemed best to present in this report to the council a suggestion for the initiation of work in which we are all interested, with the recommendation that the committee on chemical education give it careful study and consideration, with the hope that from it will come a more definite plan upon which the council and the directors can take action

A new amendment to the constitution was proposed whereby there would be added to the list of officers a president-elect who, at the end of one year, would automatically become president of the society While president-elect he would serve upon the board of directors, the executive committee, and as a member of the council, thereby gaining an insight into the affairs of the society before assuming the responsibility of the presidency This suggestion was automatically referred to a committee to be appointed by the president and which will later report to the council.

The council stood in respectful silence in memory of members deceased since the spring meeting. These included the following F T. Bayles, of Indianapolis, Ind., Bertram B Boltwood, of Yale University; J. G. Edward Cullmann, Lock Haven, Pa , Edward H. Darby, Rome, N. Y , Herbert M. Hill, Buffalo, N Y.; Norman E. Holt, London, England; Victor Lenher, University of Wisconsin, C. F Mabery, Case School of Applied Science (retired); H. P. Talbot, Massachusetts Institute of Technology, and Geoffrey Wayman, Newcastle-upon-Tyne, England.

The council accepted the invitation of the Minnesota Section, the headquarters of which are in Minneapolis, to hold the annual or autumn meeting in that city in 1929

CHARLES L. PARSONS,
Secretary

SCIENCE

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CONTENTS

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REFLECTIONS OF A CHEMIST[1]

ANTHROPOLOGISTS divide the era of human existence into ages according to the material of the implements used during a given period—the Stone Age, the Bronze Age and the Iron Age Far be it from my thoughts to dispute the correctness of this classification, but it does seem a misrepresentation or a wrong characterization to continue the present, or even the preceding, century in the iron age With the advent of the twentieth century, at the latest, the count of a new age begins What shall be the name of this age? Your reply may well be anticipated—chemistry Not your partiality or mine prompts this reply It is the verdict of facts, for the advances from the stone to the bronze and from the bronze to the iron age are really the results of the progress of the art of chemistry

The rôle chemistry is playing in the world affairs is too well known to require elaboration In its broadest embrace—colloidal, catalytic, biological, therapeutic and what not—chemistry is the moving principle of this world of ours It is nothing less than life and death! We all know the wonders chemistry has accomplished within the short space of time it has been given a systematic unprejudiced trial These accomplishments and the potentialities of chemical science have also been well advertised, perhaps a little too much The chemically untutored will expect too much and too soon, with resulting disappointment and reflection on the science and its followers

IMPORTANCE OF PURE SCIENCE

A far more important problem and one requiring our immediate and undivided attention is so-called "pure chemistry" I should rather like to call it "science of chemistry" in contradistinction to the practical application of chemistry which would be more correctly designated as the "art of chemistry"

Pure science is the protoplasm of applied science It is the brick and mortar of our sky-scraping buildings of industry and commerce Our civilization of which we are so proud, the comforts of life we are enjoying, are wholly built on discoveries emanating from the search for scientific truths, from the pursuit of science for the sake of the science itself As Secretary Hoover has very tersely put it, "It is in the soil

[1] Presidential address delivered at the seventy fourth meeting of the American Chemical Society, Detroit, Mich, September 5 to 10, 1927

of pure science that are found the origins of all of our modern industries and commerce."

The relationship between the "science" of chemistry and its varied and multitudinous applications is quite apparent to the chemist, but one or two of the thousands of examples may be cited here. About one hundred and twenty years ago, Sir Humphry Davy, in his pursuit of scientific knowledge for the sake of knowledge, discovered a method of separating the "refractory" metals potassium and sodium from their combinations. Based on this fundamental discovery, Hall, an American, and Heroult, a Frenchman, prepared the metal aluminum. But for the availability of this metal, aviation would still have been a midsummer night's dream. This metal has also added immensely to family happiness. Aluminum kitchen utensils are easy to wash and keep clean, making less work in the household and consequently stabilizing domestic felicity.

This year is the sesquicentennial of the revelation of a simple and great scientific truth. This revelation, known to few and appreciated by still fewer, is the foundation of a very live branch of the applied science of chemistry. In 1777, a French chemist, immortal Lavoisier, enunciated the principle of exchange of gases in respiration. He demonstrated that oxidation in the body and ordinary combustion are analogous processes. This simple scientific discovery marks the real beginning of the science of metabolism. This offspring science of Lavoisier's investigation is, to be sure, still in its infancy, but it is of incalculable importance. It is the very foundation of our existence. What blessings are in store for future generations when this science will have grown to manhood? Disease may then be an unknown term.

We are living on the scientific researches of a hundred or more years ago. We are plucking the fruit of trees of knowledge planted by our forebears. We have worked hard and fast to get all we can out of the funds of discoveries of past centuries, but we can not much longer go on harvesting without planting. We owe to posterity what past generations have provided for us. Shall we fail in our duty and shall we go back on our indebtedness? Our country is spending large sums of money to make available and to extract all the good from the accumulated stores of science, but we are slow to replenish these stores for future generations with fresh materials.

Nature is loath to reveal her secrets. She yields her treasures of knowledge only to those who have consecrated themselves to their quest. No scientific discovery has ever been made by accident or overnight. Archimedes spent many a sleepless hour before he discovered the simple law of displacement of liquids—specific gravity. The falling of an apple did not drop the laws of gravitation into Newton's head. It took him years of hard and patient labor to investigate and propound this law. Nor did the ring formula of benzene come to Kékulé in a dream.

Scientific discovery is the product of three elements—effort, time and genius. Genius is a gift Heaven rarely bestows upon us. We can not bank on it. But we have learned from the laws of physical chemistry that the lack in one factor can be made up by increasing the other. Owing to the enormous benefits we are deriving from scientific discoveries bequeathed to us in the past, we, especially in this country, are in a position to increase the effort factor in the equation.

THE "PHILOSOPHY" OF CHEMISTRY

The significance of chemistry in life processes and its relation to health and disease are beginning to dawn upon us. The achievements and potentialities of the science in peaceful pursuits are becoming recognized and appreciated. Of its force and potency in war we need not be reminded. In our pursuits of the material advantages of chemistry we are liable to overlook and forget its spiritual side, its cultural and educational qualities. Education and culture, terms so commonly used, are but incompletely understood and still less definable. Although at times the conception of culture is purposely corrupted, education misinterpreted and pseudo-cultures substituted and worshipped, honesty and truth are *a priori* the first and last prerequisites of genuine culture and education. The first, uppermost and last principle in chemistry is veracity and honesty. Said Goethe, "The history of a science is the science itself." The history of chemistry clearly shows that success results when truth, and truth only, is courted and adhered to. Disappointment and failure to themselves, their friends, if any they had, and in the long run to the world at large, have followed those—alchemists and their ilk—who pursued the dishonest method of making gold. The names of some of these have survived in history only as object lessons of ridicule. But immortality to themselves, and untold treasures of genuine gold to the world, have come to those who followed the truthful path of science. The first commandment in the curriculum of the study of chemistry is honesty and truth. Such is the irresistible force of this precept in our science that when a student fails to heed it he is automatically eliminated.

Some classes of business people—though to be sure they are back numbers, and in the minority—maintain that chemists make poor business men, because they are too honest and truthful—an unconscious tribute to the science and the high culture of its propounders and followers.

Besides the material advantages it brings to the

world, chemistry is a truly "philosophical" science, in the sense of philosophy as conceived and defined by the great and pure philosophical minds of Socrates, Plato and Seneca. To them philosophy is to teach men to form their souls, knowledge is to be sought for the good of the mind Our science preeminently fulfils these requirements Knowledge and contemplation of chemical phenomena, the very varied manifestations of the science, and the subtle and wonderful forms it assumes can not fail to uplift the soul and broaden and purify the mind

THE CHEMIST'S EDUCATION

The education and training the industrial chemist should have to make him fit and competent in his career is receiving much attention, both from educators and industrialists Because of the great share of responsibility that is more and more devolving upon the chemist, the importance of this question is self-evident But in our zeal to hit the spot we are perhaps shooting a little over the mark The tendency in our curriculum is to stress the applied and industrial chemical courses I very much doubt that this path will lead to the desired goal Let me repeat that the industrial achievements of the chemist have resulted from the inspiration he received from his knowledge of the science Our great and well-known chemical engineers of to-day have been raised on the undiluted milk of the pure science

Just as in the nutrition of the body a properly balanced food diet must be maintained to insure health and normal development, so it is with the education of the chemist He must be given a carefully balanced training in the science of chemistry and its application And I am of the opinion there is decidedly less danger when the ration is increased in the science than the reverse The greatest names known to science, and to scientific professions, have not during their college careers specialized in the fields they made famous Overspecialization in youth narrows the mind and stunts its development. Give the chemist student the tissue-building material, the fundamentals of science, impart to him its spirit, then when he goes out to accomplish his life work he will shape and mold the materials according to the need of time and place and will breathe life into them As in the words of Lowell:

New occasions teach new duties,
Time makes ancient good uncouth,
They must upward still and onward,
Who would keep abreast of truth

GEORGE D ROSENGARTEN

DOES THE NET ENERGY VALUE OF FOOD DEPEND UPON THE PURPOSE FOR WHICH IT IS USED IN THE BODY?

THROUGHOUT his work on the net energy values of feeds for cattle, Armsby[1] has continually kept in mind the probability that the net energy value of a feed varies with the nature of its disposition in the body, for example, varying when used for fattening or for milk production This probability of a variable utilization of food energy was based in his mind upon the difference in composition of the products formed, indicating differences in the metabolic reactions concerned in the use of food in the basal metabolism and in its conversion into tissue, fat, milk, etc. In the case of milk production, for instance, certain conversions of nutrients are considered as occurring with no loss of energy as heat, while the conversion of carbohydrates to fat is supposed to involve a definite heat liberation This conception appears to be equivalent to the assumption that the heating effect of food on the animal is determined to a considerable extent by the chemical reactions to which it is subjected after absorption, since the use to which the food is put could obviously have no effect upon the reactions occurring within the alimentary canal.

This conception of Armsby seems to be quite generally held among those laboratories in this country and Europe that are doing calorimetric work upon farm animals, and a number of experiments recently appearing in the literature[2] have been specifically concerned with the relative utilization of the energy of farm feeds in maintenance, fattening and milk production

It becomes a matter of importance, therefore, to consider what experimental evidence may be cited in favor of the belief that the stimulating effect of ingested food upon animal metabolism is due to the nature of the metabolic reactions to which it is subjected and whether some other conception may not be more readily defended. The theory appears to assume that certain metabolic reactions liberate energy which can be used in maintaining cellular life and activity before being dissipated as heat, while

[1] Armsby, H P, "The Nutrition of Farm Animals," New York, 1917, pp 361, 395, 497–8, 563

[2] Hanson, N, Kungl Landtbruksakademiens Handlingar och Tidskrift, 1923, Fries, J A., Braman, W W, and Cochrane, D C, U S Dept Agr Bul. 1281, 1924, Forbes, E B, Fries, J. A, Braman, W W, and Kriss, M, *J Agr Res*, 1926, xxxiii, 483, Møllgaard, H., "New Views regarding the Scientific Feeding of Dairy Cattle," Copenhagen

other metabolic reactions liberate sensible heat only The latter type of reactions only would be involved in the specific dynamic effect of food This conception is essentially identical with that put forward by Rubner[3] twenty-five years ago However, Rubner's theory resulted more as a revulsion against the older theory of Zuntz that the heating effect of food was due solely to the work of digestion, absorption and excretion, than as a probable interpretation of certain specific experimental data The logic that Rubner used in defending the theory is not convincing at the present time

In more recent times, Lusk has accumulated much evidence inconsistent with Rubner's theory In the case of the specific dynamic action of amino acids, Lusk[4] has shown that the reactions of deamination and urea formation are not involved, since two amino acids, glutamic acid and aspartic acid, exert no specific dynamic action in the body, although evidence of their deamination was obtained Furthermore, although glycine and alanine exert powerful dynamic effects, the products of their deamination, glycollic and lactic acids, exert only inconsiderable effects upon heat production[5] Lusk has also found that, under certain conditions, the specific dynamic effect of glycine may be as great as the total gross energy content of the amino acid, a result quite unexplainable on the basis of Rubner's theory

With regard to the specific dynamic effect of glucose, it has been shown by Anderson and Lusk[6] that the ingestion of 70 gms of glucose by a working dog is without effect upon its heat production, although in the same dog at rest a very marked effect is produced In both cases, oxidation of glucose occurred, and hence, according to Rubner's theory, the specific dynamic effect should be the same Baumann and Hunt[7] observed a definite effect of the ingestion of 25 gms of glucose in the normal rabbit, but no effect in the thyroidectomized rabbit, although with both groups of animals oxidation of glucose was occurring as indicated by the respiratory quotient

The fact that the ingestion of small amounts of foods may produce no effect on heat production is significant in this connection According to Rubner's theory, the specific dynamic effect of a food material should be proportional to the amount ingested when it is being used for the same purpose. However, Lusk has found that his experimental dogs showed no response to the ingestion of 10 or 20 gms of glucose, although with 50 to 70 gms marked increases in heat production were observed Similarly, it has been shown that the ingestion of a small breakfast by human subjects does not appreciably affect a subsequent basal metabolism determination[8]

Among human subjects there are certain pathological conditions, such as certain types of obesity, certain diseases resulting from endocrine deficiencies and certain neuroses, in which the specific dynamic effect of food is either non-existent or distinctly subnormal.[9] To explain this situation on the basis of Rubner's theory would necessitate the assumption that in these disorders the metabolic reactions are markedly abnormal and are all of the type in which liberated energy can be completely utilized in covering the energy requirements of the tissues The improbability of this assumption requires no elaboration

Finally, if the specific dynamic action of food were due to the metabolic reactions to which it is subjected, one would expect that it could be calculated from the composition of the food, its digestibility and the average heating effects of the different nutrients of which it is composed However, Armsby[10] has shown quite conclusively that this can not be done by any rational method in the case of cattle Similarly, in the case of dogs, the heating effect of a protein can not be predicted from its amino acid constitution[11]

From these considerations, it appears that Rubner's theory of the specific dynamic effect of food is not in agreement with many of the observed facts of energy metabolism, and hence is no longer tenable It is interesting to inquire, therefore, if any other theory would lead to the conclusion that the heating effect of food on metabolism will vary depending upon the manner of its utilization

The theory that Lusk sponsors on the basis of his own extensive investigations is that the specific dynamic effect of food is due to a stimulating effect on cellular oxidations, brought about either by the mere presence of an excess of oxidizable matter in the intercellular fluids (in the case of sugar and fat) or by a stimulus of some other type not so clearly definable (in the case of amino acids) The theory

[3] Rubner, M, "Die Gesetze des Energieverbrauchs bei der Erhährung," Leipzig and Vienna, 1902, pp 356–407.

[4] Lusk, G, *J Biol Chem*, 1915, xx, 555, Atkinson, H V, and Lusk, G, *Ibid*, 1918, xxxvi, 415

[5] Lusk, G, *J Biol Chem*, 1921, xlix, 453

[6] Anderson, R J, and Lusk, G, *J Biol Chem*, 1917, xxxii, 421

[7] Baumann, E J, and Hunt, L, *J Biol Chem*, 1925, lxiv, 709.

[8] Benedict, C G, and Benedict, F G, *Boston Med and Surg. J.*, 1923, clxxviii, 849.

[9] Plaut, R., *Deutsch. Arch. klin. Med.*, 1922, cxxxix, 285; 1923, cxlii, 266 Liebesny, P, *Biochem. Z.*, 1924, cxliv, 308. Wang, C C, and Strouse, S, *Arch. Intern. Med*, 1924, xxxiv, 578

[10] *Loc cit*, pp 667–673

[11] Rapport, D, *J Biol. Chem*, 1924, lx, 497

does not lead one to suppose that the ultimate destination of the food in metabolism is a factor in determining its specific dynamic effect, since this effect depends primarily on the concentration of nutrient material within and around the cells For a given intake of food, any factor that would tend to vary this concentration during absorption would have a corresponding effect upon heat production This nutrient concentration in the tissues would be depressed by any factor increasing the rate of disposal of the excess food material, such as muscular activity or mammary activity Hence, on the basis of Lusk's theory, one would expect a smaller heating effect of a given amount of food in a lactating cow than in a dry cow, though no constant difference would be expected for different amounts of milk produced and different amounts of food consumed If the cow is a high producer, it is evident that in the first few months of lactation, when the animal is in a condition of "physiological underfeeding," the food consumed would presumably exert only a minimal heating effect,[12] and would thus possess a high net energy value In the later stages of lactation, when the animal may be laying on fat due to overfeeding, the heating effect of the same amount of food may be much greater, if the rate of fat deposition is much less than the rate of milk formation, as it quite probably is At this time, the net energy value of the food would be less than at first

On similar reasoning, it would appear that the net energy value of food fed at the maintenance or submaintenance level would be higher than at the higher levels, not because of the different metabolic reactions involved in fattening as compared with maintenance, but because of a probable slower rate of withdrawal of nutrients from the intercellular fluids in the deposition of fat than in the satisfaction of contemporary energy requirements However, the difference would probably not be a constant one, since the heating effect of a unit of food would presumably vary in each case with the level of feeding On the same grounds, it would be expected that the net energy value of food would be greater when muscular activity is occurring simultaneous with absorption of food from the intestinal tract, than when the animal is at rest, on the other hand, work performed in the post-absorptive period would be without influence on the utilization of food energy

[12] Thus, Widmark and Carlens (*Biochem Z*, 1925, clvi, 454) observed that the blood sugar content of lactating cows was less than that of dry cows, and that the depression from the normal value was in rough proportion to the amount of milk produced. The lowest values observed were less than half (0.040 per cent) the average value for dry cows (0 085 per cent.).

It appears, therefore, that Lusk's experimental work affords no grounds for believing that the manner in which food is utilized determines the extent of utilization through its effect on the specific dynamic action of the food It is true that the net energy value of a food may be expected to be different with animals functioning in a different manner, but it would seem that no characteristic or even approximately constant net energy value can be assigned for a given function, and that no constant relation of net energy values among different functions can be assumed In particular, it appears unjustifiable to assume that, in an animal utilizing food in a number of different ways, so much metabolizable energy is being used for maintenance, and so much for milk production, since, if mammary activity increases the net energy value of the food by preventing as great a "metabolism of plethora" as would otherwise occur, this increased utilization would apply as much to the *food used for maintenance as to that used in the* production of milk[13]

Another possible explanation of the heating effect of food on animal metabolism is that the acid products of digestion may be effective stimuli to cellular activ-

[13] A specific illustration of this point may aid materially in appreciating this argument In a recent article by Forbes, Fries, Braman and Kriss (2), estimates are made of the utilization of metabolizable energy for milk production, by making certain definite assignments of metabolizable energy for maintenance and body increase, and relating the remainder to the energy content of the milk produced Thus for Cow 874 (in Tables 5, 6 and 7) it is assumed that the metabolizable energy used for maintenance suffers a loss of 22 3 per cent as heat, that used for body gain a loss of 38 4 per cent, and hence that used for milk production a loss of 27 8 per cent. The total heat increment for this cow is an experimental observation, but the factoring of it in this manner on the basis of results obtained on the cow when dry is an interpretation that involves theoretical considerations that have neither been justified nor discussed Hence, the conclusion that the percentage utilization of metabolizable energy for milk production was, for this cow, 72 2 per cent, is an interpretation of the same character The essential assumption upon which these interpretations are based is that when food is serving a number of purposes in the animal body simultaneously, the utilization of food energy for each purpose is independent of that for the other purposes, in other words, that the heating effect of food used for maintenance is the same whether the animal is producing tissue or milk simultaneously or whether it is only maintaining its *status quo* While this assumption superficially appears to be a reasonable one, on analysis it is seen to imply that the causes of the heat increment due to the ingestion of food are related directly to the methods of food disposal, *i.e*, to the metabolic reactions concerned in maintenance, body gain and milk production.

ity This explanation has been proposed by Benedict,[14] though direct attempts to verify it have not been successful[15] It is conceivable, however, that acid stimulation may be an important factor with ruminants, in which large amounts of organic acids resulting from extensive bacterial fermentations are absorbed from the intestinal tract But obviously this theory also can not be construed to favor the view that a definite net energy value for a food is characteristic of each animal function, or that the percentages of utilization of metabolizable energy for different functions bear a constant relation to one another

Finally, in ruminants at least, the chemical, bacterial, glandular and muscular events occurring in the alimentary canal, or in its accessory organs, during digestion are known to result in a definite and considerable increase in heat production, an increase that may account for a large percentage of the total heat increment following the ingestion of food But it appears that these events, and the accompanying heat losses, would bear no relation to the events subsequently or simultaneously occurring on the other side of the gastro-intestinal mucosa They would presumably be related, more or less constantly, to the amount of food consumed, and its physical and chemical make-up, particularly as this bears upon the extent and rapidity of its digestion, but would be quite unrelated to the manner in which the food is utilized after absorption

It appears, therefore, that the determination of the relative net energy values of feeds for animals in different functional conditions is being approached on the basis of assumptions, not only without experimental justification, but even in contradiction to established experimental findings The results obtained, in consequence, are being given a significance that they do not seem to possess, in all probability Hence, a different working hypothesis should be adopted. Since Lusk's experimental work and the theories that he has deduced from it appear to offer the most plausible explanation of the specific dynamic action of food—the only calorigenic effect of food that would conceivably be related to its disposal in metabolism—a working hypothesis based upon these theories would seem to be the safest guide in future investigations of the net energy values of food for farm animals[16] In a broad way, these theories differentiate three general lines of investigation, involving studies of (1) the heating effect of different amounts of food in animals in the same functional condition, (2) the heating effect of the same amount of food in animals in different functional conditions, and (3) the influence of internal factors, such as heredity and endocrine activity, upon the specific dynamic effect of food The first study is concerned with the rate of establishment of the metabolism of plethora, the second with the rate of its depression due to withdrawal of food by the tissues and the third with the response of the tissues to a given plethora stimulus, in other words, with the irritability of the tissues

H H Mitchell

College of Agriculture,
University of Illinois

[14] Benedict, F G, Trans 15th Intern Congress Hyg and Demography, Washington, D C, 1912

[15] Lusk, G, *J Biol Chem*, 1921, xlix, 453, Taistra, S A., *ibid*, 479, Chanutin, A, *ibid*, 485

[16] It may, of course, be objected that Lusk's work was done with carnivora and that the conclusions from it can not be assumed to apply to herbivora. However, there is little reason for believing that the energy metabolism of the two types of animals is fundamentally different In any case, the theories of Rubner as well as those of Lusk were based upon experimental work with carnivora. Until there is definite reason for doubting the applicability of experimental data so obtained to farm animals, they may be considered a safe guide upon which to base working hypotheses.

RALPH GORDON LUSK

Dr. Ralph Gordon Lusk, instructor in geology at Harvard University, died suddenly with heart failure in New York City on July 27, at the age of thirty-one years, just as he was entering upon his career as a geologist He was born July 14, 1896, at Manchester, Iowa, where his father, the Reverend C F Lusk, was at that time pastor of the First Baptist Church His mother's maiden name was Grace A Hilbrant Ralph Lusk was educated in the public schools of Iowa, and in March, 1918, he enlisted in the U S Navy and was sent to the Great Lakes Naval Training Station On April 1 of the same year he was married to Neva Belle Frederick at Lake City, Iowa. At Great Lakes, the heart ailment which finally caused his death was first developed and by September he was discharged for vocational rehabilitation He entered Denison University that fall and graduated with the class of 1922, after making geology his major subject The next year was spent as a graduate student at the University of Chicago At Denison he was elected to membership in Phi Beta Kappa and at Chicago to Sigma Xi In 1923–24 he was instructor in geology at Denison and in 1924 he entered Harvard University as an Austin Teaching Fellow in Geology He was appointed instructor in geology in 1926 and in June, 1927, he was awarded the degree of doctor of philosophy at Harvard, having previously received the degree of master of science from Chicago

During the summer of 1922, Ralph Lusk had served as field assistant to Kirtley F Mather, of the U S Geological Survey, in Colorado and New Mexico Shortly thereafter he was appointed assistant geologist on the survey and spent the summer of 1923 in Montana as assistant to A. J. Collier Similarly during the field season of 1924 he was engaged in geological mapping in northeast Colorado for the United States Geological Survey, and during the field season of 1925 and 1926 he was in eastern Tennessee as geologist of the State Survey. This field work supplied the basis for his doctor's thesis as well as shorter technical articles He was also one of the joint authors of a government bulletin, now in press, descriptive of the oil and gas resources of northeast Colorado

Dr Lusk was a member of Beta Theta Pi and a Mason He is survived by his widow and four children twin daughters, aged eight, a son, Ralph Gordon Lusk, Jr, aged four, and a baby daughter, nine months old

KIRTLEY F MATHER

HARVARD UNIVERSITY

PROFESSOR ALBRECHT KOSSEL

GEHEIMRATH PROFESSOR ALBRECHT KOSSEL, until recently professor of physiology in Heidelberg University, director of the Heidelberg Institute for the Study of Proteins, Nobel prize winner, known for his elucidation of the chemistry of the proteins and of nuclear chromatin matter, died unexpectedly, after a very short illness, in Heidelberg on July 5

Professor Kossel in a very real sense was the founder of modern biochemistry It was his conception of the structure of the proteins, following upon his study of the simplest of these substances, the protamines, a conception which was confirmed and established by synthesis of artificial or synthetic proteins by Emil Fischer, work undertaken at Professor Kossel's suggestion and request, which gave to biochemistry its great impetus in the last years of the nineteenth century and led to the wonderful outburst of activity in this field.

Professor Kossel was a fine-looking man of medium height, of a simple, friendly, affectionate and generous nature. He had nothing of the insolence, conceit and arrogance so often associated with the Prussian, but he was a real scientific man, modest, kindly, simple, sincere, with a brilliant imagination and indefatigably at work in the laboratory even up to the time of his death. He retained his youthfulness of appearance, of mind and outlook and all of his faculties to the very end of his life. To his great honor it may be recalled that he did not sign the ridiculous pronunciamento of the German professors at the start of the great war. He did not sympathize with those who brought on the war, although after his country was engaged he gave it loyal support

Ever since the death of Hoppe-Seyler he had been editor of the *Zeitschrift fur Physiologische Chemie*, being associated for a year or two and until the death of the latter with Professor Baumann, but being thereafter sole managing editor This journal, established by Hoppe-Seyler about 1879, was for many years the only journal in the world devoted exclusively to biochemistry and it is one of the finest journals of science of the present day, its papers being almost without exception valuable contributions to the subject and several of them being classics in their fields

Mrs Kossel, whom many American students and friends will remember with great affection for her kindness, sincerity and intelligence, and who was related to some of our most distinguished scientific men, died in 1912 Two children survive them, a son, the distinguished physicist of Kiel, Professor Walther Kossel, and a daughter, Gertrud Kossel, and three grandchildren, Albrecht, Dierick and Irene Kossel Professor Kossel was a brother of the bacteriologist, Professor H Kossel, who died about two years ago

Professor Kossel had many pupils, his laboratory in Heidelberg being filled before the war with students from all lands His death is felt by them all as a great personal loss It removes another of the great men of science of Germany, the greatest glory of that country in the years just preceding the war As one after another of these great men pass away it is as if one light after another were being extinguished and Germany entering again into the twilight of learning

ALBERT P MATHEWS

SCIENTIFIC EVENTS

THE IMPERIAL AGRICULTURAL RESEARCH CONFERENCE

THE Imperial Agricultural Research Conference which opens in London on October 4 has, according to a report in the London *Times*, as its main objects the establishment of closer cooperation in agricultural research work throughout the empire, the setting up of additional research stations in tropical and subtropical countries, the creation of greater imperial bureaus, and the recruitment, training and interchange of research workers It will be attended by seventy-five delegates of high administrative and scientific standing from the oversea parts of the empire and by many representatives from Great Britain and

Northern Ireland The Dominions and India are sending thirty delegates, and representatives of the Colonies and Protectorates will attend from Barbados, British Guiana, Ceylon, Cyprus, Gold Coast, Kenya, Leeward Islands, Malaya, Mauritius, Nigeria, Nyasaland, Palestine, Sierra Leone, Tanganyika, Trinidad, Grenada and Windward Isles, Uganda, Zanzibar and Sudan

Lord Bledisloe, the parliamentary secretary to the Ministry of Agriculture, is the chairman of the organizing committee, and the members of the conference, in addition to various representatives of the Ministry of Agriculture, the Colonial Office and the Board of Education, include the High Commissioners for the Dominions, representatives of the Empire Marketing Board, the Department of Scientific and Industrial Research, the Medical Research Council, the Bureaus of Entomology and Mycology, the Overseas Settlement Department, the University Grants Committee, the Department of Overseas Trade and the Forestry Commission

The importance and value of such a conference was first urged by the Agricultural Research Council several years ago, and since then the matter has been discussed by the Imperial Conference and the Colonial Office Conference Recently Lord Lovat's Committee on Agricultural and Research Administration in the non-self-governing Colonies put forward recommendations for closer cooperation on these matters The conference will be held in the Grand Committee Room of the Houses of Parliament, and will be opened on October 4 by the Minister of Agriculture In the evening the delegates will be the guests of the government at a dinner in the Royal Gallery, House of Lords Till October 7 the full conference will discuss the agenda of administrative questions, and the organizing committee anticipate that this will lead to the appointment of commissions to examine in detail and prepare reports and recommendations on the question of the extension of the system of imperial bureaus from entomology and mycology to other departments of agricultural science It is probable that recommendations will be put forward for the setting up of empire bureaus in veterinary science and for investigating soil problems and plant breeding, and also for a bureau on agricultural economics The desire of the Australian Government to set up a research institute at Queensland on subtropical agriculture will also come before the conference Specialist commissions are to be set up to bring together the delegates interested in a special subject of research and to assist in the formulation of schemes of combined research work The full sessions of the conference will be resumed on October 24 and continue for four days. During the intervening period part of a program of visits to research centers will be carried out

The University of London will hold a reception at the Imperial Institute, and the delegates during their stay in London will have the opportunity of viewing at the Science Museum a special exhibition illustrating the history of agricultural implements and of inspecting at the British Museum manuscripts and books dealing with agricultural science. Arrangements are being made at both museums for lectures on such subjects and special pamphlets will also be provided for the use of the delegates On October 14 the Vice-chancellor of Cambridge University will give a luncheon to the delegates, and after inspecting the various departments of scientific research the party will leave for Edinburgh on October 18 The headquarters of the conference will remain in Edinburgh until October 22 Afterwards delegates will have the opportunity of visiting Aberdeen to inspect the work of the Rowett Institute in relation to animal nutrition and visiting Belfast, where they will be entertained by the Government of Northern Ireland and shown the plant breeding, poultry and animal diseases research stations

The reports of the various commissions appointed will be considered by the full conference in London between October 24 and 27 On October 29, the party will visit the Rothamsted Experimental Station, on October 31 the Royal Botanic Gardens at Kew, on November 1 the East Malling Research Station, and on November 2 Oxford University, including the Institutes of Agricultural Economics Research, Agricultural Engineering and Imperial Forestry

THE BIOCHEMICAL INSTITUTE FOR THE MIDDLESEX HOSPITAL, LONDON

THE Middlesex Hospital, already distinguished by the Bland-Sutton Pathological Institute, has now, according to the *Journal* of the American Medical Association, the further distinction of an institute of biochemistry, thanks to the gift of $200,000 by Mr S A Courtauld At the opening ceremony, Mr A E Webb-Johnson, honorary treasurer of the medical school, recalled that it was only a few years since Mr Courtauld gave $100,000 to endow the chair of anatomy, "one of the fundamental medical sciences" The foundations of scientific work in the Middlesex Hospital Medical School were laid by Sir John Bland-Sutton before the war, by his gift of the pathologic institute bearing his name "Dictionaries printed before the year 1900 contain no such word as biochemistry, but the name is now familiar, and though new the science is old," said Sir John Bland-Sutton, in an address on "Biochemistry in Relation to Medicine," a science concerned with the application of the princi-

ples of chemistry and physiology to the investigation and interpretation of the phenomena of life He referred to the fact that the kingdoms of nature had been arranged in three classes mineral, plants and animals The microscope revealed myriads of minute living things concerning which biologists were puzzled to decide whether they were plants or animals Such discoveries bridged the gap between the two, and it was now the ambition of biochemists to discover the connecting link between stones and plants, in order to find out how life arose from inorganic matter He had always maintained that laboratories for investigating disease should be in close association with hospitals The future of medicine does not lie in prescribing drugs, he declared The day may come when, some of us believe, the biochemical laboratory may displace the dispensary Lavoisier, the founder of biochemistry, had his head lopped off in 1794, continued Sir John, by the "apostles of Liberty, Equality and Fraternity," on the excuse that the republic had no need for scientists Mr Courtauld had no fear that such a fate awaited him The wisdom shown in building the laboratory indicated his appreciation of the great part science played in practical medicine "We may be hopeful," he concluded, "that a discovery will one day be made within the walls of this laboratory which will make the world gape with astonishment" The institute will be a five-floor building, the four upper ones having laboratories for the study of the various branches of biochemistry, all equipped with the latest appliances

THE JOURNAL OF PALEONTOLOGY

NUMBERS one and two of a new quarterly known as the *Journal of Paleontology* appeared in July and August, respectively Numbers three and four are expected to appear in October and December In future years the numbers will appear at three-month intervals

The *Journal of Paleontology* is the official publication of the Society of Economic Paleontologists and Mineralogists

The Society of Economic Paleontologists and Mineralogists is an organization whose object, as stated in Article II of its constitution, is "to promote the science of stratigraphy through research in paleontology and sedimentary petrography, especially as they relate to petroleum geology," and whose membership is composed of members or associate members of the American Association of Petroleum Geologists engaged in such work

The Journal of Paleontology will be devoted to research in paleontology and sedimentary petrography The paleontological papers will include those pertaining to faunal distribution, stratigraphic index species, descriptions of individual faunas, relation of zones to habitats, etc Sedimentary petrographical papers will pertain to mineral zones, stratigraphic distribution, provinces of sedimentation, etc Papers will also be included which pertain to technique bearing on researches in paleontology and sedimentary petrography In fact, those papers will be included which will in any manner be helpful to those engaged in stratigraphic studies carried on either in the laboratory or in the field

The Journal of Paleontology is a quarterly publication, and will be of approximately 96 pages and 15–20 plates It is 6¾ x 9½ inches in size

Dr Joseph A Cushman is editor He is one of America's most active micro-paleontologists He has been engaged in research for many years, and is now one of the world's foremost authorities on the foraminifera He will have associated with him an editorial board to assist in matters not in his particular field

MARCUS A HANNA,
Secretary-Treasurer
SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS,
HOUSTON, TEXAS

THE RAWSON-MACMILLAN ARCTIC EXPEDITION OF FIELD MUSEUM

WILLIAM DUNCAN STRONG, anthropologist of the expedition and a member of the staff at Field Museum of Natural History, in a report made public by the director of the museum, tells how the explorers have come upon the ruins of the house, the mining pits and the improvised shipyard of Sir Martin Frobisher, who, between 1576 and 1578, led three expeditions, two for gold, into the forbidding regions of Labrador and Baffin Land Digging in the ruins, Dr Strong has unearthed fragments of brick, plaster, coal and porcelain, products which he states undoubtedly were brought over from England, and are indisputable proof that the ruins are of European, and not native Eskimo, habitations

The story of Frobisher, recalled by the museum expedition's findings, is one of the most romantic in the history of quests for riches in far parts of the earth Frobisher, with the financial assistance of a few friends, sailed from England in July, 1576, in search of a northwest passage to Cathay and India He had two tiny vessels, *The Gabriel* and *The Michael*, and thirty-five men Arriving in Labrador, they proceeded up the coast to what is now Frobisher Bay in Baffin Land Five of the men were captured by natives and never seen again Failing to find the passage they sought, the expedition returned to England, bringing some specimens of what the sailors called

"black earth" Soon a rumor spread that this black earth was gold ore Frobisher himself is thought to have believed it

In the excitement that ensued, another expedition was formed Queen Elizabeth loaned *The Aid*, a larger naval vessel, to Frobisher, and gave him £1,000 to finance the quest Men of prominence in the court also invested in the hope of recovering large fortunes In July, 1577, Frobisher, with *The Aid*, and the two vessels he had previously, and 120 men, sailed again Mining equipment was carried and miners and refiners were included among the men The following autumn the expedition returned to England with 200 tons of the "ore" While assaying, delayed in various ways, was going on, excitement mounted higher, and a third expedition was organized, with fifteen ships Plans were made to leave 100 of the men to establish a permanent settlement in the barren land, which had solemnly been taken possession of in the queen's name The fleet sailed May 31, 1578

After arrival in Frobisher Bay, dissensions arose, and the idea of the settlement was abandoned The fifteen ships, all laden to capacity with ore, returned to England in October, only to find that the assay, since completed, had determined that the ore contained nothing but "fool's gold," or iron pyrites

Dr Strong reports also having investigated what were believed by some explorers to be Norse ruins in Labrador and Baffin Land, but states all he has seen thus far are Eskimo in origin Further search is to be made for evidences of a landing by the Vikings in the region

Skeletons of three Labrador Eskimos from old stone graves, other contents of the graves, various specimens from ancient camp sites and many specimens of Eskimo handiwork in bone and stone implements have been collected for the museum

Dr Strong is now making preparations for a trip during the coming winter While other members of the expedition are working at the scientific station established at Nain, Labrador, he will go, with a native interpreter and a team of dogs, into the interior to mingle with and study the primitive Naskapi Indians These tribes, of which little is known at present, are one of the most primitive of extant peoples They are reported to be surly and untrustworthy and disinclined to welcome white intruders

RESEARCH IN MINING AND METALLURGY

FIFTEEN different research studies in mining and metallurgy are being carried on this year at the Carnegie Institute of Technology in cooperation with the United States Bureau of Mines and two advisory boards of mining engineers, metallurgists, steel operators and chemists, according to an announcement. Thirteen of the problems are being investigated by college graduates appointed as research fellows, one by a research engineer and another by an analyst

This year's work, it is announced, is a continuation of the program that has been in effect for several years. Each research fellow is making his studies under the direction of a "senior investigator" representing the Bureau of Mines and a member of the faculty of the Carnegie Institute of Technology Four of the fellowships are financed this year by the institute Other organizations contributing to the expenses and the fellowship funds are the American Gas Association, the New York Edison Company, the Philadelphia Storage Battery Company, the National Coal Association, the International Combustion Engineering Corporation, and twenty-six companies representing the metallurgical industries The latter group is financing six of the investigations

As in former years, it is announced, the results of the studies will be published in bulletin form for distribution at the close of the college year Assignments of problems to the research fellows have been made as follows

Equilibrium between manganese, iron and sulphur, by Hershall V Beasley, University of Tennessee.

Synthesis, testing and application of warning agents for manufactured gas, by Harry A Brown, Lehigh University

Formation and identification of inclusions, by John M Byrns, Case School of Applied Science

Coal ash fusibility as related to clinker formation, by Clarence L Corban, Rose Polytechnic Institute

Methods of determining inclusions, by John F Eckel, University of Kansas

Distribution of iron oxide between slag and metal, by Hyman Freeman, Georgia School of Technology

Base exchange in relation to decay and peat formation, by Raymond C Johnson, Monmouth College

Safety, costs and efficiency of distribution of electric power in coal mining, by Donald C Jones, research engineer

Physical chemistry of steel making, by Frank Morris, analyst

Relation between composition and oxidizability of coal, by Harold M Morris, Cornell College

Viscosity of open hearth slag, by Frank G Norris, Purdue University.

Composition of oils and heavy tar from distillation of coal at low temperature, by Robert N Pollock, University of Washington

Determination of relative ignitibility of low temperature coke compared with coal, by Donald L. Reed, University of Washington

Study of cause and control of abnormality in case carburized steel, by Alfred W Sikes, University of Illinois.

Physical chemistry of steel making (field studies), by R. W. Stewart, Massachusetts Institute of Technology.

SCIENTIFIC NOTES AND NEWS

PROFESSOR ALBERT A. MICHELSON, of the University of Chicago, left on September 24 for Pasadena, with the object of repeating at the Mount Wilson Observatory the Michelson-Morley experiment Dr Michelson will also make a further study of the speed of light

IT is reported in the London *Times* that English scientific men attending the International Congress of Physics, held at Como in celebration of the Volta centenary, included Dr F W Aston, of the Cavendish Laboratory of Cambridge, Professor A S Eddington, Sir Edward Rutherford and Sir J J Thomson, of the University of Cambridge, Professor W L Bragg, of the University of Manchester, and Dr J A Fleming and Professor O W Richardson, of the University of London

IN honor of an investigation on the measurement of the efficiency of the output of a dynamo, the results of which were reported to the Franklin Institute of Philadelphia fifty years ago by Dr Elihu Thomson and E J Houston, then of the Central High School, Philadelphia, the institute and the General Electric Company plan to hold a celebration in March Dr Thomson and Dr Charles F Brush, of Cleveland, Ohio, will be the guests of honor

DR HERBERT E IVES will demonstrate his invention of television in an address before the Franklin Institute of Philadelphia on November 16 He has been awarded a John Scott Medal

DR EDWARD R WEIDLEIN, director of the Mellon Institute of Industrial Research, University of Pittsburgh, and president of the American Institute of Chemical Engineers, has been elected an honorary member of the Chemical, Metallurgical and Mining Society of South Africa

DR G R MANSFIELD, of the U S Geological Survey, has been placed in charge of the combined sections of areal geology and the geology of non-metalliferous deposits Dr H D Miser is in charge of the section of the geology of fuels

MRS CARL AKELEY, widow of the explorer, has been appointed adviser in the development of the new African hall of the American Museum of Natural History

SIR MURDOCH MACDONALD has been elected president of the British Junior Institution of Engineers in succession to Engineer Vice-Admiral Sir Robert B Dixon. Sir Murdoch will take office at a meeting to be held on November 18, when he will deliver his presidential address.

AT the meeting of the International Electrotechnical Commission, which opened at Bellagio on September 12, officers were elected as follows President, C Feldmann, Delft, Holland, honorary president, Guido Semenza, of Italy, the retiring president, honorary secretary, Kenelm Edgcumbe, of Great Britain, *vice* Sir Richard Glazebrook, resigned The next meeting will be held in the United States in September, 1928. In 1930 the conference will go to Stockholm.

PROFESSOR M H INGRAHAM, of the University of Wisconsin, was appointed assistant secretary of the American Mathematical Society, in charge of arrangements for western meetings of the society, at the recent meeting of the organization in Madison Professor Ingraham succeeds Professor Arnold Dresden, who for the past eleven years has served as assistant secretary of the society Professor Dresden leaves the University of Wisconsin this autumn to become head of the department of mathematics at Swarthmore College The society commended Professor Dresden's work during his term of office in resolutions adopted at the closing business session

GRANTS made by the Committee on Scientific Research of the American Medical Association include $500 to Dr Helen Bourquin, professor of physiology in the University of South Dakota, to continue her study of experimental diabetes insipidus, and $500 to Dr C W Apfelbach, Chicago, to study some of the functional alterations of the kidneys of dogs following infarction of glomeruli, and $300 to Dr Roy H Turner to enable him to continue his researches into the gastro-intestinal microbiology in pellagra and sprue

DR G B L ARNER, agricultural statistician of the division of statistical and historical research of the U S Department of Agriculture, tendered his resignation effective on September 1 after five years' service in the bureau He has accepted a position as the chief of the bureau of vital statistics of the Department of Public Health, for the State of Pennsylvania

H ATHERTON LEE, pathologist at the Experiment Station of the Hawaiian Sugar Planters' Association in Honolulu, has resigned to accept the position of director of research for the Philippine Sugar Association in Manila, P I He will take up his new duties on November 16

MILTON E RYBERG, formerly of the division of agricultural biochemistry of the University of Minnesota, has taken up work at the Boyce Thompson Institute for Plant Research, Inc, at Yonkers, N Y, and is working on the volatile constituents of plants attacked by the European corn borer

PROFESSOR EDWARD W. BERRY has returned to Baltimore after spending three months in geological studies in Ecuador and Peru.

Dr. A. S. Hitchcock, custodian of grasses in the National Herbarium, has returned from a trip to Washington, Oregon and California. In cooperation with the Forest Service he traveled through Cascade, Deschutes and Umpqua Forests of the Cascade Mountains and the Siskiyou Forest of the Coast Range. He also visited Mount Hood and The Dalles

Dr Reid Blair, director of the New York Zoological Park, is in London on a mission to study the recent installations in the London Zoological Garden

Dr. W. V Bingham, president of the Psychological Corporation and director of the Personnel Research Federation, sails with Mrs. Bingham on *The Leviathan*, on October 1, for Paris to participate in the Fourth International Congress of Techno-Psychology Before returning to New York in November he plans to visit the J J Rousseau Institute and the International Labor Office in Geneva, the psycho-technical laboratory of The Philips' Glowlampworks at Eindhoven, Holland, and the National Institute of Industrial Psychology in London

Assistant Professor A E Emerson, of the department of zoology of the University of Pittsburgh, who represented the university at the International Congress of Zoologists at Budapest, returns from a year's study in Italy and Sweden

At the University of Pittsburgh, leaves of absence for one year have been granted to Professor S H. Williams, zoology, for study and research in Germany, and to Assistant Professor K. S. Tesh, chemistry, for study and research at the University of Illinois

A memorial tablet has recently been unveiled in the naval hospital of St Anne at Toulon in honor of Dr Louis Tribondeau, an eminent clinician and bacteriologist, who has given his name to a well-known stain He died of influenza at Corfu in 1918

Industrial and Engineering Chemistry reports that a Priestley Medallion has been presented to the Priestley Memorial Museum, Northumberland, Pennsylvania, by Josiah Wedgwood and Sons, Ltd, of Etruria, England The portrait is in white on the usual Wedgwood blue background and is 12 x 9 inches It is mounted in a deep walnut frame and the inscription on the back reads as follows "Presented to the Priestley Museum by Messrs Josiah Wedgwood and Sons, Ltd., Etruria, England This replica has been made from the original mould still in the possession of the firm January, 1927" Josiah Wedgwood, the founder of the firm presenting the medallion, was a friend of Dr Priestley and many letters passed between them

It is proposed to establish an Adami research fellowship in pathology in the University of Liverpool in memory of John G. Adami, F.R.S, who was vice-chancellor of the university during the last years of his life For this purpose it is proposed to collect the sum of £3,000 Should the sum collected be insufficient, an alternative proposal is the endowment of an Adami Library of Pathology in connection with the medical library

Frank Springer, a lawyer of New Mexico, known for his work in invertebrate paleontology, died on September 22, aged seventy-nine years.

Charles McMillan, professor emeritus of civil engineering at Princeton University, died on September 19 in his eighty-seventh year He was the oldest member of the Princeton faculty and of the American Society of Civil Engineers

Dr Clarence Hoffman, associate professor of anatomy at Jefferson Medical College, Philadelphia, died suddenly on September 1

Sir Arthur Everett Shipley, F R S, the zoologist, master of Christ's College and from 1917 to 1919 vice-chancellor of the University of Cambridge, England, died on September 22 at the age of sixty-six years

The death is announced at the age of fifty-three years of Professor Rudolf Magnus, who held the chair of pharmacology at Utrecht

At the autumn meeting of the American Society of Civil Engineers in Columbus, Ohio, which will be held from October 12 to 15, two days will be devoted to the discussion of the Mississippi Flood Problem, and its various phases will be treated by eminent authorities from both official and private life Secretary of War Dwight F Davis and Major-General Edgar Jadwin, chief of engineers, will present the views of the War Department Other government departments cooperating will include U. S. Geological Survey, through Nathan C. Grover, chief hydraulic engineer; the Mississippi River Commission, through Colonel C W Kutz, and the Interior Department through Elwood Mead, commissioner of reclamation. Many other students of flood problems will contribute to the discussion, such authorities as Arthur E. Morgan, of Dayton, Ohio; John F. Coleman, of New Orleans; Colonel William Kelley, of Buffalo, and C. E. Grunsky, of San Francisco.

The sixth International Congress of the History of Medicine was held at Leyden in July, under the presidency of Dr. J. G. de Lint, lecturer on the history of medicine in the University of Leyden. According to a report in *Nature* there were over eighty papers on the program. Dr C. A Crommelin gave an address illustrated by portraits of Huyghens, the Musschenbroeks and other contemporary Dutch scientific workers. Addresses illustrated by kinemato-

graph films were given by Drs. A. Scherbeck and W. H. van Seters on the work of Leeuwenhoek and Swammerdam Lectures were also given on the history of the treatment of nervous and mental diseases, by Dr C. O Ariëns Kappers; the doctor in caricature, by Mr C Veeth, and the bier of the surgeons and druggists preserved in the church at Wokkum, by Dr. J B. F van Gils An exhibition was arranged in the Municipal Museum at Amsterdam consisting of pictures by Rembrandt, Jan Steen, Teniers and other works from various Dutch galleries, sculpture, books and *incunabula* illustrating the history of medicine An exhibition of instruments made by famous Dutch physicists in the seventeenth, eighteenth and commencement of the nineteenth centuries was held at the physical laboratory of the University of Leyden The next congress will be held at Rome in 1930, but the International Society of the History of Medicine will form a section in the Congress of the History of Science to be held next year at Oslo

THE International Congress of Hygiene will be held in Paris from October 25 to 28, under the chairmanship of Professor Léon Bernard, director of the Institut d'Hygiène of the Faculté de Médecine of Paris The following topics have been chosen for discussion (1) The relations of social insurance systems to the public health, speakers, Kuhn, Copenhagen, Holtzmann, Strasbourg, and Briau, Paris, (2) factors influencing the recrudescence of smallpox throughout the world, and the means of combating them, speakers, Professors Ricardo Jorge, Lisbon, Jitta, The Hague, and Camus, Paris; (3) the hygiene of instruction camps, speaker, Médecin-Inspecteur Sacquepée, professor at École d'Application du Val-de-Grâce Addresses will also be delivered by Professor Madsen, president of the committee on hygiene of the League of Nations, on "The International Organization of Hygiene", Professor Nuttall, of the University of Cambridge, on "The Relations of Parasitology to Hygiene," and Professor Ottolenghi, professor of hygiene, University of Bologna, on "The Question of Vitamins from the Hygienic Point of View."

A MR. C. SPIERER, of Geneva, Switzerland, has been an experimenter and inventor of ultra-microscopes for colloidal investigation and has devised an ultramicroscope involving a new principle of double illumination. Dr. Ellice McDonald, of the University of Pennsylvania, has been in correspondence with Mr. Spierer for several years in regard to the application of his instruments to colloidal research in cancer and has applied Mr. Spierer's methods. This has finally resulted in a gift by Mr. Spierer for use in research of all his microscopic equipment to Dr McDonald and Professor Seifritz, of the University of Pennsylvania.

PROTECTING the sea-front along the Scripps Institution of Oceanography, University of California, assembly bill 368 has been passed by both houses of the legislature and signed by Governor Young This bill creates a biological reserve along the shore-line of the institution, and prevents all fishing and collection of marine life to a mean low tide depth of six feet, which includes outlying rocky ledges This action was taken because of the threatened extinction of many kinds of marine animals in these waters

UNIVERSITY AND EDUCATIONAL NOTES

BY the will of the late Eldridge R Johnson, formerly president of the Victor Talking Machine Company, the University of Pennsylvania receives $800,000 for the establishment of the "Eldridge R Johnson Foundation for Research in Medical Physics." It is stipulated that a sum not exceeding $200,000 may be expended for a building and equipment for the foundation Any income from the balance will go to further the "study and development of physical methods in the investigation of disease and in its cure, the study of the important physical agencies or properties, such as heat, light, electricity, sound, etc, in their varied relations to the life of man, and to carry out investigations for the improvement of the instrumental applications of such agencies to medical purposes."

Nature states that the Albert Agricultural College, Glasnevin, Dublin, which has been engaged in agricultural teaching and research since 1851, has recently been reorganized so as to accommodate the enlarged Agricultural Faculty of University College, Dublin (National University of Ireland), and will henceforth be under university control The following appointments have been made director and professor of agriculture, Professor J P Drew, professor of plant pathology, Dr P A Murphy, lecturer in animal nutrition, Mr E. J Sheehy, lecturer in agricultural chemistry, Mr Geo Stephenson, lecturer in agricultural botany and bacteriology, Mr. M J. Gorman, lecturer in plant breeding, Mr. M Caffrey, lecturer in horticulture, Mr G O Sherrard.

DR. HENRY HARTMAN, professor of pathology, University of Texas School of Medicine, Galveston, has been appointed dean of the medical school, succeeding Dr. William Keiller Dr Hartman for many years has been a teacher in the college and since March, 1926, has been the acting dean

DR. PAUL D FOOTE, late of the Bureau of Standards at Washington, has been appointed to a senior fellowship in the Mellon Institute and a lectureship in the department of physics of the University of Pitts-

DR. Robert T Hance, of the Rockefeller Institute of Medical Research, has been appointed professor and acting head of the department of zoology Professor F L Bishop retires as dean of the Schools of Engineering and Mines to devote full time to the department of physics Dr. W E Baldwin, instructor in chemistry, goes to the Johnstown Junior College of the university as assistant professor and director of the department of chemistry.

DR G L FOSTER, assistant professor of biochemistry in the University of California Medical School, at Berkeley, has resigned to become associate professor of biochemistry in the Medical School of Northwestern University

R B GREEN, who has held the position of lecturer in anatomy at the College of Medicine, Newcastle-on-Tyne, for the past five years, has been elected professor of anatomy in the University of Durham, in succession to Professor R Howden

DR WILHELM TRENDELENBURG, who was recently called from the professorship of physiology at Tubingen to the University of Berlin, has been succeeded at Tubingen by Dr Armin Tschermak von Seysenegg, of the German University at Prague

DISCUSSION AND CORRESPONDENCE

ARSINE FROM FUSED GLASS

RECENTLY while drawing a large tube of borosilicate glass to capillary size a very pronounced garlic-like odor was observed. After a number of failures to duplicate the conditions it was found that the odor could be noticed only during the process of drawing the glass and thus while continuously forming a fresh surface.

The experimental procedure was as follows. The center portion of a short length of tubing was fused to a thick mass in an oxygen-natural gas flame. If the fused mass was held close to the nose no odor could be detected until the glass was stretched when at once the odor of garlic was noticed.

The experiment was repeated with a second lead-free borosilicate glass This glass had a somewhat higher melting point and the odor could not be detected in this case unless the fused glass, after removing from the flame, was allowed to cool until it could be stretched only with difficulty Several samples of so-called soft glasses gave negative results.

The odor was so striking that it was compared with that of arsine from an arsine generator. Several observers agreed that the odors from the fused glasses and of the arsine were identical. Since the two glasses giving positive results were found on analysis to contain in one case 0.5 per cent. and in the other 0.8 per cent. of arsenic oxide, one might safely conclude that the odor from the glass is due to arsine were it not for the fact that arsenic vapor is itself supposed to have a garlic-like odor.

When arsine is heated in the air it is largely oxidized to As_2O_3, the equation for the main reaction being as follows.

$$4As + 3O_2 = 2As_2O_3. \quad (1)$$

Water vapor which is always present in the air may aid in the oxidation according to equation (2),

$$2As + 3H_2O = As_2O_3 + 3H_2 \quad (2)$$

Arsenic oxide, As_2O_3, has no odor either in the solid or gaseous phase and since hydrogen is odorless it would appear, unless there are other products of the oxidation, that gaseous arsenic is responsible for the garlic odor which accompanies the heating of arsenic in the air

There is another possible product not of the oxidation, but of the reduction of arsenic, namely, arsine The hydrogen formed according to equation (2) might reduce some of the arsenic to arsine as follows

$$2As + 3H_2 = 2AsH_3, \quad (3)$$

or better still, the effect of water vapor on arsenic vapor might be considered as a single reaction.

$$4As + 3H_2O = As_2O_3 + 2AsH_3. \quad (4)$$

Here part of the arsenic acts as an oxidizing agent and is reduced to arsine while the remainder is oxidized to As_2O_3.

The analogous reaction between water vapor and phosphorus has been shown to take place[1] very readily at high pressures and temperatures thus:

$$4P_4 + 12H_2O = 3H_3PO_4 + 5PH_3 \quad (5)$$

If reaction (4) takes place only to a very slight extent when arsenic is heated in air we can readily explain the similarity of its odor to that of arsine. In dry air reaction (4) may even be delayed until contact of the arsenic vapor with the moist mucous membrane of the nostrils.

It is therefore suggested, first, that the odor of arsenic vapor is due to the presence of arsine, second, that under the proper conditions arsine is formed in the fusion of glass containing arsenic compounds.

H. M. ELSEY

WESTINGHOUSE RESEARCH LABORATORY,
EAST PITTSBURGH, PA

[1] Ipatiev and Nikolajev, Ber. 59 (B), 595 (1926).

INDICATIONS OF THE TRANSMISSION OF AN ACQUIRED CHARACTER IN FLAX

IN the great field of plant and animal growth, change of form and type through development and adaptation, evolution is always in evidence. No two individuals are ever quite identical. Darwin seems to have conclusively proved that the thought "once a species, always a species" is untenable. Since his epoch-making labors, most biologists are quite agreed that species, varieties and strains continually show changes of type and character, but how do these changes come about?

In all types where open crossing is possible, it is easy to understand that an endless number of combinations of form and character may arise through various unions of units of form, quality or character. Thus, through Mendelian studies and methods it is easy for the formalists, given to mathematical methods, to account for any number of noticeable forms and qualities. Hence, if followed to the ultimate conclusion along such line of reason, species, varieties and individuals again become fixed recurring entities which can not be changed or modified in actual nature except it be through the recombination of certain fixed hereditary particles.

Of late, plant and animal breeders and leading geneticists have held that these recombining parts or particles are either represented by the chromosomes, or are contained within them as the genes. The genes, as such, approach philosophical or hypothetical units of heredity. They are assumed to be carriers or bearers of hereditary characters. The whole scheme of thought is entrancingly interesting, and appears to work out so well for properly contrasted units of form or character that it can be looked upon as an almost certain basis for predicting the general type of progeny which may follow upon the development of any given set of cross-mating.

It is but fair to say that this line of investigations and thought carries very great hope for plant and animal improvement, including man himself. It is, perhaps, the greatest working hypothesis yet given to the biologist.

However, the old thought that acquired characters may be transmitted and do in fact account for evolutionary progress and development, need not be dismissed as wholly untenable. The Mendelian theories and formulas do not explain the origin of the genes, nor is it proved that these may not be subject to change. It is with this thought in mind that I call attention to the wonderful work done by many workers in immunization against disease in animals, and to the yet more pronounced work of procuring disease resistant and climate resistant plants. In these lines of work there rests evidence of progressive evolution that can not be accounted for through the hypothesis of permanent, never-changing chromosomes or by the genes which may be lodged therein. If these never change in substance or character, then there could never have been a beginning, hence no change or evolutionary development.

In my own work of developing numerous strains or varieties of wilt-resistant flax, these points become very plain. From numerous varieties of non-resistant flaxes, I have been able through constantly submitting the same to ever-increasing degrees of disease attack, to bring about a high degree of immunity to Fusarial attack, without any associated evidence of cross-fertilization. Equally pronounced results are indicated as against flax rust.

When these strains which have accumulated a certain degree of resistance to a fungus attack are crossed artificially upon non-resistant strains, they transmit a definite degree of immunity to the resulting progeny. Thus we are now able to develop and throw the resistance to Fusarial wilts through crossing into any type or variety of flax desired through artificial crossings of the resistant strains upon the non-resistant strains or varieties. Mendelianists have suggested that such resistance as we have thus procured is but accidentally selected or picked up because of "fortuitous field crosses." However, flax is a closely fertilized plant and in all our work I have not seen sufficient evidence of open crossing to account for the rapid accumulation of wilt resistance.

During many years of continuous planting side by side, it is possible to grow numerous varieties and selection strains without there appearing in the product any evidences of breaking up of the noticeable characters of flowers or of other morphological parts because of fortuitous crossing. We have grown hundreds of individuals from individual plants and from individual seeds for the distinct purpose of observing this feature. It probably does not occur in sufficient extent to in any way affect the results in accumulating wilt resistance which we have here obtained.

Our results indicate no other conclusion than that wilt resistance may be accumulated rather rapidly by a non-resistant strain or variety and that, when it is thus accumulated, it is transmitted from generation to generation through seed; and, further, that when once obtained to a certain degree, it can be fixed through artificial crossing.

This appears to be the final proof of the transmission of an accumulative quality. Besides, if such a quality of resistance can not be so accumulated in nature, how can we account for such features as the

gradual but rather rapid acclimation in corn? If such qualities do not arise in nature by or through gradual accumulation in association with constant crossing, how then did the first gene or unit of character arise? How did the first plant become resistant for any character?

I write simply to suggest that it is well for plant physiologists, ecologists and plant breeders to hold the open mind over against the thought of "Once a gene, always a gene"

HENRY L BOLLEY
NORTH DAKOTA AGRICULTURAL COLLEGE

MECHANISM OF BUFFER ACTION IN SOILS

WHILE working on "The Rôle of Pectin in Jelly Formation" it was found that the buffer action of the pectin solutions was due entirely to the impurities in the solution and not to the colloidal properties of the pectin.

It previously had been assumed, while outlining the method for the attack of the problem involving a fundamental study of the mechanism of buffer action in soils, that the buffer action exhibited by certain types of soils was, for the most part, due to the colloidal content of the soils This assumption was based on the fact that soils high in colloidal matter showed considerable buffer action while soils low in colloidal matter showed scarcely any buffer action

In view of the results obtained with pectin solutions the plan of attacking the soils problem was changed so that now an attempt is being made to attribute the buffer action exhibited by the several soils to the impurities held by the colloidal fraction, perhaps by electrostatic attraction, double decomposition or neutralization of alkali with an acid or *vice versa*

Some preliminary work has been done, using a Portsmouth loam, high in organic material The colloidal fraction was separated and electro-dialyzed thus removing the greater part of the iron, aluminum, manganese, calcium, magnesium, sodium, potassium and other elements, as well as sulphates, phosphates and other acid radicles As the electro-dialysis progressed samples were frequently withdrawn and their buffer action determined It was found, during this preliminary work with this particular type of soil, that as the impurities were progressively removed from the colloidal organic fraction of the soil, the buffer action steadily decreased until, the impurities becoming negligible, the sample exhibited scarcely any buffer action.

As a result of this preliminary investigation the work is being continued, using various soil types with the hope of obtaining data sufficient to substantiate the claim that buffer action peculiar to soil types laden with colloidal material is not due directly to the colloidal properties of the soil but rather to the salts, metallic or acid radicles that are held by the colloidal fraction.

PHILIP B. MYERS,
GERALD M. GILLIGAN
DELAWARE AGRICULTURAL
EXPERIMENT STATION,
NEWARK, DELAWARE

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR OBTAINING INFECTIVE NEMATODE LARVAE FROM CULTURES[1]

CREEPING eruption, a human skin disease frequently encountered during the summer in some of the Southern areas of the United States, was shown by Kirby-Smith, Dove, and White[2] to be caused by third-stage nematode larvae. Later White and Dove[3] demonstrated that dogs and cats are concerned in the causation of the disease

Much culturing has been necessary in the search for the adult worm of the causal parasite and in other studies in which infective larvae have been used. The useful Baermann apparatus was first employed to recover the infective larvae from the cultures Later a still simpler method was devised which reduced very materially the time required. This latter method has been employed for a year and a half and has proved to be entirely adequate for the problem. An outline of it is given in the present article

The method makes use of the fact, often observed, that the larvae of a number of parasitic nematodes as they approach the third larval stage and the close of the free-living period tend to migrate from the medium in which they are growing The apparatus traps many of the migrating worms.

Convenient and sufficient equipment consists of crystallizing dishes 125 to 150 mm. in diameter, watch-glasses slightly larger than these dimensions respectively, Petri dishes 100 to 125 mm., test-tubes 20 by 150 mm, filter papers 9 to 12 cm., a spatula with a 4-inch blade, a test-tube rack, a three-quart boiler with cover, animal charcoal, and sterile water. Brief steaming in the covered vessel suffices for all sterilization that is needed.

The charcoal and the feces are properly mixed conveniently in one of the larger watch-glasses and transferred to the half of a Petri dish, with a moistened

[1] Read before the Washington Helminthological Society, April 16, 1927

[2] Kirby-Smith, J. L, Dove, W. E., and White, G. F., "Creeping Eruption," *Arch. Dermat. and Syph.*, xiii, Feb., 1926, 137–173.

[3] White, G. F, and Dove, W. E., "Dogs and Cats Concerned in the Causation of Creeping Eruption." Official Record, U. S Dept. Agr, Oct. 27, 1926, V.

filter paper covering the bottom. Sterile water is poured into a crystallizing dish sufficient to cover the bottom and into it is placed the half Petri dish containing the culture A watch-glass is used as a cover. The apparatus (fig. 1) after labeling is placed for

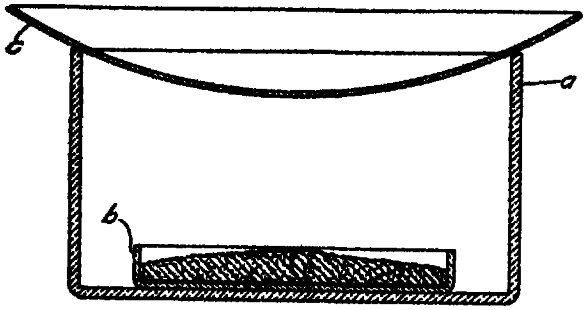

FIG 1 Apparatus used for culturing nematode larvae *a*, Crystallizing dish, *b*, Petri dish with charcoal feces mixture, *c*, watch glass cover Water surrounds the Petri dish equal to about one half its depth

incubation of the culture preferably where a high humidity can be maintained.

Many of the larvae on approaching the third larval stage migrate from the culture and are trapped in the water surrounding the Petri dish In collecting them the watch-glass cover is removed and the half Petri dish with the charcoal culture is lifted out, preferably with forceps, and placed into it The water containing the larvae is poured from the crystallizing dish into a test-tube which is then stood perpendicularly in the rack The worms soon gravitate to the bottom of the tube, after which the water above may be pipetted off, leaving the larvae concentrated. The apparatus with the charcoal mixture may then be reassembled and sterilized by steaming.

A number of modifications of the apparatus and the method may be made to meet the worker's special needs When there is but a small amount of culture it is well to use the half Petri dish with the bottom up A Syracuse watch-glass or the top of a Coplin jar serves well in place of the Petri dish. Room temperature, especially in summer, may be substituted for the more constant one of an incubator.

A modified form of the apparatus has been used to reduce somewhat the amount of fungous growth in the culture when this seemed desirable An aluminum pan of the diameter of the crystallizing dish, with the inclined side perforated, is placed beneath the watch-glass cover and supported by the edge of the dish. Into the pan is poured a few cubic centimeters of an aqueous solution of formalin. A 15 per cent solution has been employed successfully, but the optimum strength should be determined by each worker to meet his own needs

As many as 8 species of nematodes, representing 4 genera, have been cultured and isolated successfully by this method, an ample number of larvae of each species being obtained. In no case, however, have all the larvae in the culture been recovered Additional ones may be had by transferring the charcoal culture to the Baermann apparatus

While using the method one soon learns of its limitations and its advantages The larvae are recovered from the cultures in relatively clean water Only infective forms are obtained A considerable leeway is permitted as to the time larvae may be collected from the apparatus. The first larvae trapped may be poured off, more water added, and the apparatus reassembled for later migrations In field work in connection with studies on creeping eruption Dove and the writer have found this method for obtaining infective larvae very convenient and efficient.

In making studies on the migration of nematode larvae, Looss[4] trapped them in water but apparently did not employ the observation in devising a routine method for obtaining larvae from cultures

Among those who have taken advantage of the migrating tendency of larvae in devising methods suitable for their studies is Darling,[5] who used Syracuse watch-glasses in the center of which he placed 3 to 5 cc of stool and added sterile water until the feces were surrounded with fluid The worms for study were taken from this margin of water. Fülleborn[6] also made use of this habit, employing agar plates. The charcoal-feces mixture was placed on this medium in the center of the Petri dish The infective larvae migrating from the culture over the agar cause their trails to be inoculated with bacteria. By the growth of these the courses taken by the worms are readily observed Sandground,[7] commenting on different culture methods, points out that the one employing the Baermann apparatus has served the needs of certain of his problems better than others which he has used

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[4] Looss, A., "The Anatomy and Life-History of *Agchylostoma duodenale* Dub." *Recds. of Egypt Govt Sch. of Med.*, Cairo, 1911, *IV*.

[5] Darling, S T., "Strongyloides Infections in Man and Animals in the Isthmian Canal Zone," *Jr Exp. Med*, July, 1911, xiv, pp. 1–24

[6] Fülleborn, F., "Nachweis von Ankylostomum durch Plattenkot-cultur." Vorl. Mitteilg. *Arch f. Schiffs und Tropenhyg.*, 1921, pp. 121–123.

[7] Sandground, J. H., "Biological Studies on the Life-Cycle in the Genus *Strongyloides* Grassi, 1879," *Amer. Jr. of Hyg.*, May, 1926, vi, 337–388.

SPECIAL ARTICLES

TRANSMISSION OF POTATO WITCHES' BROOM TO TOMATOES AND POTATOES

(*Preliminary Report*)

A TRANSMISSION FROM POTATOES TO TOMATOES

IN the greenhouse of the Montana Agricultural Experiment Station at Bozeman, Montana, stems of 18 Earliana tomato plants 20 to 75 cm. tall were inarch-grafted on to the stems of 18 potato plants which showed severe symptoms of witches' broom. The potatoes were grown from seed pieces inoculated with tuber plugs from potato tubers infected with witches' broom These potato plants were selected because they developed large stems before the witches' broom appeared Seven of these 18 grafted tomato plants showed definite symptoms of a peculiar disease within 53 days after grafting Two of the other grafted tomato plants exhibited the disease symptoms within 73 days after grafting. The top of one plant became chlorotic within 13 days, and another within 30 days after grafting. Of the nine grafts which transmitted the disease, five were known to be true grafts, and graft unions probably occurred also in the others The witches' broom potato plants which transmitted the disease to the tomatoes were of the following varieties. Bliss Triumph, Russet Burbank, Perfect Peachblow, Blue Victor and Rural New Yorker

The other nine grafted tomato plants of the above series, and 15 ungrafted tomato plants of the same age and variety showed no symptoms of the disease. Two of the checks were in the same pots with tomatoes which developed the disease

The symptoms of the disease transmitted from witches' broom potato plants to tomato plants were: The new leaflets had very prominent, yellow-chlorotic margins, they were extremely dwarfed and often rugose. In a small percentage of the leaflets, the lower sides of the veins were purple. Many of the new leaflets had very narrow leaf blades. None of the leaflets was upward rolled In many cases the rhachises of the leaves were prominently downward curled The new tops of the affected plants were very chlorotic They bloomed profusely and produced many small tomatoes, the buds and flowers developed normally.

Western yellow tomato blight and linear and rugose tomato mosaics have some of the symptoms described above Since the disease considered here does not have enough of the diagnostic symptoms of any of these three tomato viroses for classification in one of them, and because the symptoms are very similar to the first symptoms of witches' broom in the potatoes from which the disease was transmitted, this disease is tentatively called tomato witches' broom. This is probably the first report of the transmission of the virus of potato witches' broom to a different host.

B TRANSMISSION TO VARIOUS POTATO VARIETIES

Potato witches' broom was shown by Young and Morris[1] to be transmissible from diseased to healthy potatoes. The primary and secondary symptoms of the disease were well described by Hungerford and Dana.[2]

Seed pieces of rogued stocks of several varieties of potatoes were inoculated with witches' broom by inserting cork borer plugs from witches' broom tubers into holes made in the seed pieces. Thirty-four of the resulting plants developed the first symptoms of witches' broom within 35 to 114 days after inoculation These tuber plugs formed graft unions with the seed pieces in many cases

The following data include the cases of transmission previously reported and summarize the data secured: Of the 138 seed pieces plugged with witches' broom scions, 45 produced plants with typical symptoms of witches' broom. The progeny of two other plants showed severe symptoms of witches' broom although the parents exhibited no symptoms of disease. From tuber scions of Bliss Triumph and Jersey Peachblow potatoes, witches' broom was transmitted to Bliss Triumph, Russet Burbank, Perfect Peachblow, Idaho Rural, Green Mountain, Irish Cobbler, Blue Victor, Six Weeks, Mills' Prize, Colorado Pearl and Rural New Yorker potato plants

Similar tuber plug inoculations failed to transmit the disease to Norwegian Yam, Early Michigan, Early Rose, Producer and Up-to-date potato plants. Russet Burbank and Rural New Yorker plants affected with witches' broom did not exhibit marginal chlorosis of the leaflets. The other nine varieties affected with this disease showed prominent marginal chlorosis, at least in the early stages of the disease

Forty-five normal seed pieces of Bliss Triumph potatoes, plugged with scions from healthy tubers of this variety, were planted in the greenhouse where they grew for 84 days. None of them developed any symptoms of viroses (virus diseases). Besides these, four Bliss Triumph seed pieces were plugged with scions from Irish Cobbler and Netted Gem tubers,

[1] Young, P. A., and H. E. Morris. "Potato Witches' Broom is a Transmissible Disease," U. S. D. A. Plant Disease Reporter 10 (3): 26–28, 1926.

[2] Hungerford, C. W., and B. F. Dana. "Witches' Broom of Potatoes in the Northwest," Phytopath. 14: 372–383, 1924.

and three Netted Gem and two Irish Cobbler seed pieces were plugged with scions from healthy Bliss Triumph tubers None of these seed pieces plugged with scions from healthy tubers developed plants with disease symptoms. About 4,000 potato plants uninoculated with witches' broom were closely observed while they developed to maturity Only one of them developed witches' broom symptoms, and it very probably represented late infection of the parent plant in the field. Hundreds of tubers produced by potato plants affected with witches' broom were grown in the field and the greenhouse; only one of the resulting plants failed to develop witches' broom symptoms.

Mealy bugs (Coccidae) were colonized on potato vines severely affected with witches' broom, and then transferred to four healthy Bliss Triumph potato plants and two healthy Earliana tomato plants; no evidence of disease transmission was seen Aphids taken from potato vines with severe witches' broom were allowed to feed on the sprouts of two Irish Cobbler potatoes Neither the resulting plants nor their progeny produced vines with witches' broom symptoms Seven other attempts to transmit witches' broom by means of aphids all failed. In the field in 1925 and 1926, normal Bliss Triumph potato plants grew beside potato plants severely affected with witches' broom Since aphids were abundant on both the normal and the diseased potato plants late in the season, tubers from eight of the normal plants were planted in the greenhouse at different times. All the plants grown from these tubers remained healthy, showing that aphids had not carried the disease to their parents from the adjacent vines which had witches' broom.

By leaf mutilations 62 Bliss Triumph, Netted Gem and Irish Cobbler potato plants 12 to 30 cm. tall were inoculated with witches' broom The inoculations were repeated on many of the plants two or three times, at intervals of a few days These experiments were performed in the greenhouse during two winters None of the inoculated plants developed witches' broom symptoms Eighteen normal potato plants were grown in pots with plants severely affected with witches' broom, but none of the normal plants became diseased. The method of field dissemination of witches' broom is not yet determined.

Most of the witches' broom plants seen in many fields have shown severe symptoms so that the disease was recognizable soon after the sprouts appeared. Tubers infected with witches' broom produce many chlorotic, spindly sprouts. There now appears to be no constant difference between the upright and prostrate forms of witches' broom in the field. In one row of 98 hills of Bliss Triumph potatoes, 56 of the hills were severely affected with witches' broom. The seed pieces weighed about 50 g apiece and were quarters of tubers The large size of the seed tubers indicated that they very probably came from parent vines infected late in the season. Plants infected early in the season rarely produce tubers of marketable size.

In the greenhouse the development of a potato plant successfully inoculated with witches' broom by tuber grafting is as follows The plugged seed piece produces a plant which remains normal in growth and appearance for 31 to 114 days If the mosaic virus be present in either the stock or the scion, its symptoms appear within the first month or two and precede the witches' broom symptoms The presence of mild or crinkle mosaic does not interfere with the development of witches' broom. The first symptom of witches' broom consists of an increasingly prominent chlorosis of the new leaflets on one or more stems In most varieties of potatoes the margins of the new leaflets are chlorotic yellow Red or purple colors often occur in the new leaflets, particularly under field conditions The top of the plant then elongates with abnormal rapidity, and produces a stem which is cylindrical with enlarged nodes; it is chlorotic and often purpled.

Many chlorotic, spindly axillary branches develop all along the stem and bear typical witches' broom leaves The abnormally numerous axillary branches, sometimes borne by plants with severe spindle tuber, are thick, green, and not spindly, so they are unlike those borne on witches' broom plants Filamentous aerial stems are valuable in diagnosis when they occur; they are often numerous Small numbers of these peculiar stems occur in the field

Spindly sprouts appear as aerial or subterranean stem branches at the base of the plant and grow very slowly, representing witches' broom in severe form The tubers already formed often sprout and add to the number of spindly basal sprouts. Vigorous plants may have 200 or more very slender stems, and a large number of very small tubers. In most cases the top of the plant continues to grow rather rapidly for the next few months and may reach a height of 1 m Such plants frequently bloom earlier and more profusely than normal plants. The old leaflets produced while the plant was normal slowly die and are replaced by the dwarfed, chlorotic leaves produced by the spindly tops and branches The dwarfed, new branches often bear only minute, simple leaves. Filamentous aerial stems and aerial tubers commonly occur on all parts of the stems. Flowers were borne on the aerial tubers of a few plants, but this is an uncommon symptom.

Finally, the tall main stems die completing the transformation of the normal potato plant into a

plant severely affected with witches' broom Thus, the primary and secondary symptoms of witches' broom intergrade All that remains is the group of spindly basal sprouts only 5 to 30 cm. tall which, with proper care, remain alive for several months longer. If kept for eight or more months, the old stems successively die and are replaced by new sprouts and their branches which continue to arise from the tubers in or near the surface of the soil.

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P. A Young

Montana Agricultural
Experiment Station,
Bozeman

STUDIES ON THE GOLGI APPARATUS OF THE MAMMARY GLAND

The present study is a corroboration and extension of the work of Da Fano on the Golgi apparatus in different physiological conditions of the mammary glands. The primary objective of this work was to find if any evidence could be obtained as to the supposed transformation of the Golgi apparatus into a granular material that would be extruded from the cells together with the products of their activity

It was found by using Da Fano's cobalt-silver-nitrate method that the epithelial cells of the mammary glands of rats during the later stages of pregnancy and full activity show a great hypertrophy of the apparatus together with a transformation into a reticular and granular-like structure. During lactation a part of the apparatus migrates from near the nucleus and spreads throughout the cytoplasm of the cell, concentrating at its sides in the direction of the lumen

By use of Brouha's modified Flemming fixative it was found that the Golgi bodies could be demonstrated with ease in the lumen of the actively secreting gland —a condition unknown to Da Fano. The technique used to demonstrate the Golgi bodies in the lumen is as follows

(1) Pieces of mammary glands of the white rat were fixed for two days in the modified Flemming fixative, which consists of.

Sol A	Saturated sol of Corrosive sublimate	600 gr.
	Glacial acetic acid	40 gr.
Sol. B	Osmic acid	1 gr
	Chromic acid	1 gr.
	Distilled water	100 gr.

To four parts of solution A add one part of solution B.

(2) The tissue is then washed in water from one half to one hour

(3) Dehydrate, clear in xylol and embed in paraffin

(4) Section from 3 to 5 microns and fix sections on slides by the albumen method

(5) Transfer sections through xylol and decreasing strengths of alcohols into distilled water

(6) Sections are then placed in 0 2 per cent solution of gold chloride plus 1 drop of acetic acid to every 20 cc of solution

(7) Wash slides in distilled water and place in 5 per cent solution of sodium hyposulphite for two minutes and wash over again in distilled water

(8) Dehydrate and clear in xylol

(9) Mount in balsam

Slides prepared by the above described technique shows the Golgi apparatus in the lumen in the form of small round bodies These bodies are apparently located in the presumably cytoplasmic layer surrounding the fat droplet which is derived from the cytoplasm of the secreting epithelium When the fat is dissolved the Golgi apparatus remains as granular-like bodies marking the outer limiting membrane of the droplet. Large numbers of these figures may appear in one lumen which, before the fat is dissolved, presents a deeply stained mass varying from approximately 2 to 15 microns in diameter In some cells which were fixed just before extrusion of the fat droplet the Golgi bodies may be seen in the bulging limiting membrane of the cell describing a convex arc into the lumen of the gland

It is also possible to demonstrate the Golgi apparatus in both the cell, and in the lumen of the actively secreting gland by use of Lundford's modified osmic acid method, although it is much more difficult to dissolve the fat from within the droplet after such long osmic acid impregnation However, the Golgi bodies may be seen quite clearly in the peripheral layer surrounding the fat droplet before it is extruded from the cell and also in the lumen of the active secreting gland.

It would seem from this evidence that the Golgi bodies play a part in the phenomena of secretion. However, the exact part they play in this process is yet imperfectly known That they are reformed within the cell after extrusion with the secretory products from a fragmentation of the remaining apparatus would seem the most plausible explanation from the evidence at hand. These observations would likewise suggest that the Golgi apparatus is a definite structure capable of a morphological existence without its cellular environment.

These studies are being continued.

H. W. Beams

Zoological Laboratory,
University of Wisconsin

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CHEMISTRY IN RELATION TO BIOLOGY AND MEDICINE WITH ESPECIAL REFERENCE TO INSULIN AND OTHER HORMONES[1]

YOUR speaker to-day is one who is primarily a worker in the field of experimental medicine, a chemist, if at all, only in so far as an imperfect mastery of your science became necessary for the solution of physiological and pharmacological problems that could not be undertaken or even formulated if their chemical aspects were to be ignored Under the circumstances I can but feel a sense of deep unworthiness in venturing to address an audience in which are gathered so many distinguished representatives of your noble science. I am highly appreciative of the signal honor conferred upon me by the board of award of the Chicago Section of the American Chemical Society in the bestowal of the Willard Gibbs Medal and I beg the members of the board to believe that I am duly grateful to them

There exists in our day an essential unity of outlook and interest among the majority of professional chemists, biologists and medical men in respect to the physical and chemical aspects of life This unity of interest and unanimity of opinion in respect to the applicability of the laws of physics and chemistry to the elucidation of vital processes have their origin far in the past and date from a time long before chemistry had attained to its present dignity as an independent science It is not my purpose to attempt to record even briefly the history of chemistry or that of medicine, subjects that have been so well treated by many learned men of both professions, but I would ask your forbearance toward an imperfect sketch of the points of contact between your professional ancestors and mine. I leave out of consideration here any reference to such contacts in the ancient or later alchemical periods, or to Arabian science in Western Europe, further than to remark that alchemy, which at its best combined far-reaching metaphysical speculations with a crude experimental chemistry, had, as one of its several aims, not alone the transmutation of the baser metals into gold, thus abolishing that "great disease, poverty," but also

[1] The Willard Gibbs lecture delivered before the Seventh Midwest Intersectional Meeting on the occasion of the award of the Willard Gibbs Gold Medal by the Chicago Section of the American Chemical Society, May 27, 1927.

the cure of fleshly ills and the gift of "perfect health and length of days." Certainly the search throughout the long alchemical period for the "elixir of immortal health" supports the claim for this medical aspect of alchemy, even without proofs on the literary side

To-day the modern alchemists among you have, in a most remarkable manner and in a most concrete way, actually realized the age-long dream of your predecessors. Paneth well describes the chemical and the medical actions of the modern philosophers' stone, radium, in the following words

> Thus we see that in a certain sense radium possesses the first and principal property ascribed to the philosophers' stone it has the power of transmuting elements, although not of producing gold And, oddly enough, even in respect to the second property which was ascribed to the philosophers' stone radium seems to have gotten something from its fabulous predecessor it is a very valuable aid in the treatment of some severe diseases, although not a perfect remedy for every illness. So that to a certain degree the radium rays really produce the two very different effects of the philosophers' stone, transmutation and healing

Even in the later alchemical period the older professions of medicine and pharmacy furnished opportunity, though often grudgingly given, for the development of chemistry, and they may justly be said to have been the parents of modern chemistry Throughout this period, as in ancient times, there existed a large number of industries, such as the metallurgical industries, enamel- and glass-making, painting, brewing and wine-making, to give only a few examples But the practice of these ancient arts could not lead to the development of a chemical science as long as the true character of organic principles of the elements and their compounds remained unknown Especially close was the connection between chemistry and medicine in the days of the iatro- or physician-chemists of the sixteenth and seventeenth centuries In the first half of the sixteenth century, at a time when the crude chemistry of that day was still entangled with the traditions and even downright impostures of alchemy, there appeared an extraordinary man, Paracelsus (1493–1541), "the very incarnation of the spirit of revolt" (Osler), who must indeed be regarded as one of our ancestors in both branches of learning Remember that in his day medicine was already a long established and powerful profession and this bold innovator in chemical physiology, pathology and pharmacology, who heaped scorn on Galen and Avicenna, very naturally aroused the hostility of many of the leading physicians of the day.

He is the most notable figure among the earlier physician-chemists and, in the words of the historian E v Meyer, to him belongs incontestably the credit of fusing chemistry and medicine in the first half of the sixteenth century, of forcing both into new paths and of freeing chemistry from the shackles of alchemy. Up to our time some of his writings have appeared in no less than five hundred editions He declared it the true purpose of chemistry not to be the making of gold but the preparation of medicines "Alchemy is neither to make gold nor silver: its use is to make the supreme sciences and to direct them against disease" This too narrow a conception of the science was soon to be broadened out by the iatro-chemists of the century and more, following his death He stated clearly that the processes of the animal organism are chemical in their nature and that health is a function of, or dependent on, the composition of the juices and tissues of the body. Even in regard to the rôle played by air in respiration, I find Robert Boyle, more than a century later, citing him in support of his own views, as saying "that as the stomach concocts meat and makes part of it useful to the body, rejecting the other part, so the lungs consume part of the air and proscribe the rest" Medical historians have occupied themselves more with an analysis of the medical achievements of Paracelsus, the Luther of medicine (Osler), than with his chemical discoveries, and his significance is perhaps greater for medicine than for chemistry. He is certainly of great importance in the history of chemical therapeutics and pharmacology Sudhoff says of his work in these fields

> He was the first one to show how to separate the active principles from drugs and to use them in tinctures and extracts He made important discoveries in chemistry: zinc, the various compounds of mercury, calomel, flowers of sulphur, among others, and he was a strong advocate of the use of preparations of iron and antimony In practical pharmacy he has perhaps had a greater reputation for the introduction of the tincture of opium—''labdanum'' or laudunum—with which he effected marvelous cures and the use of which he had probably learned in the East (Osler)

Naturally, I can not pause to give more than a very incomplete sketch of this innovator whom I here mention because of his constant insistence that physiological processes are chemical processes and that drugs by their chemical properties can bring about favorable chemical alterations in a diseased body

It has for many years been a custom with me to characterize the vital importance of certain defensive substances and the products of internal secretion present in our bodies in the aphorism: We are walk-

ing drug stores. On reading Sudhoff's reprint of the *Labyrinthus medicorum errantium* of Paracelsus (1538), a little meaty classic, I was delighted to find that four centuries ago our author had already elaborated this idea at length

> Also in human beings there is a natural apothecary in which are found all things as in the world (the macrocosm), good and bad, simples and composites, however they be named. As the outer world, the macrocosm, contains visible pharmacies and visible physicians, so in the microcosm, that is to say, in the human being, there is present an invisible pharmacy and an invisible physician who produces, prescribes, dispenses and administers suitable remedies as occasion demands Let it be known to all men then that had not God created and placed in the bodies of men natural remedies and a natural physician, then, notwithstanding all the efforts of our physicians, not a single creature of earth would remain alive

In this quite modern fashion Paracelsus here restates the enduring canon of Hippocrates—Νούσων φύσιες ιατροί—better known to us in its later paraphrased form as *vis medicatrix naturae* Professor Max Neuburger, the learned professor of the history of medicine at Vienna, truly remarks that the problem of nature's healing power is probably the most weighty of all that have engaged the thoughts of physicians during thousands of years

The iatro-chemists were the physiological chemists of their day They possessed the highest scientific and humanistic culture of the time and historians of science agree in the opinion that chemistry profited greatly by passing into their hands The study of their attempts to elucidate the phenomena of life and the chemical alterations associated with disease is a fascinating one The physiologists, biochemists and pharmacologists of our day have at their disposal a great wealth of discovery in the more exact sciences—the gifts of the intervening centuries, but even with all this assistance modern iatro-chemists still find themselves trying, though confidently, to hack their way out of the jungle so boldly and gaily entered by their predecessors nearly three hundred years ago

Naturally you will call to mind also, as every one must, the iatro-physicists of this period It is thought that the physiological speculations of Descartes, as given in his treatise *De Homine*, had a great influence in turning men's minds to the possibility of basing physiology on physics and chemistry, but there is little doubt that the teachings and discoveries of Harvey had the greater influence on the development of iatro-physics This phase of science, however, lies outside our present discussion.

I must content myself with recalling to your minds a few of the names of the iatro-chemists of this period —van Helmont and Sylvius, of whom Michael Foster, with a first-hand knowledge of their writings and those of their pupils, has given such an enlightened and sympathetic account in his Lane Lectures on the History of Physiology in the sixteenth and seventeenth centuries—Tachenius, Willis, Mayow, Lémery, Hooke, Peyer, Brunner and many others of this time might be named who forwarded both chemistry and medicine in the latter half of the sixteenth and well on into the seventeenth century

One great man, Robert Boyle, nobleman of wealth, stands out prominently in the seventeenth century, one whose name is revered alike by physicists, chemists and medical investigators This greatest chemist of his day, though not trained as a medical man, nevertheless, says one of his biographers, Thomas Birch, "went very accurately through all the parts of Physic" A study of his writings furnishes ample evidence of his acquaintance with medicine and the medical theories of his day This great man even occupied himself with therapeutical questions and published "collections of choice and safe remedies, for the most part simple and easily prepared, very useful in families and fitted for the service of country people" The historian Neuburger in his scholarly treatise entitled "Die Lehre von der Heilkraft der Natur im Wandel der Zeiten" devotes several pages to Boyle's views in regard to the respective rôles of "nature" and the physician "in restoring the distempered body to its pristine state of health," and states that Boyle's opinions on these matters were not without value and precipitated many controversies.

Boyle was particularly fascinated by that fundamental problem—the nature of the respiratory process —of which he says that "it is a subject of that difficulty to be explained and yet of that importance to human life that I shall not regret the trouble my experiments have caused me if they are found in any degree serviceable to the purpose for which they were designed" I have been surprised to learn, in my study of his writings, with what ardor Boyle pursued the effects of diminished air pressure, with his improved Guericke "pneumatic machine," on a great variety of animals. Bees, flies, butterflies, caterpillars, humming birds, sparrows, larks, mice, fishes, eels, unborn puppies, all served as objects of experiment in the study of this great problem which was to occupy the attention of his successors down to our day. At a time when, in spite of some earlier approaches to the truth, it was still generally held that the sole purpose of breathing is to cool the blood,

Boyle's experiments forced upon him the conviction expressed as follows:

> Without denying that the inspired and expired air may be sometimes very useful by condensing and cooling the blood that passes through the lungs, I hold that the depuration of the blood in that passage is not only one of the ordinary, but one of the principal uses of that passage But I am also apt to suspect that the air doth something else in respiration which hath not yet been sufficiently explained.

The last sentence suggests that Boyle may have had a prevision, years before the discovery of oxygen, that this "something else" is the respiration of the tissues themselves

After citing the opinion of Paracelsus, an opinion not based on experimental evidence, that "the lungs consume part of the inspired air and proscribe the rest," Boyle, on the basis of his own extensive experimentation, makes the prophetic statement

> It seems we may suppose that there is in the air a little vital quintessence, if I may so call it, which serves to the refreshment and restauration of our vital spirits, for which use the grosser and incomparably greater part of the air being unserviceable, it need not seem strange that an animal stands in need of almost incessantly drawing in air

This "vital quintessence" is of course the later oxygen of Priestley and Scheele

All of his experiments lead him to support

> the theory of Moebius that the genuine use of respiration is the ventilation not of heart but of the blood in its passage through the lungs, in which it is disburthened of those excrementitious steams proceeding for the most part from the superfluous serosities of the blood

Truly, Boyle could touch no subject without leaving his mark on it For example, the respiration of fishes, "being animals without lungs," also excited his curiosity, and he "thinks it not altogether absurd to say that their gills seem somewhat analogous (as to their use) to lungs" His experiments with the air pump had taught him that there is "wont to lurk in water many little parcels of interspersed air, whereof it is not impossible that fishes may make some use, either by separating it when they strain the water through their gills or in some other way."

Time and occasion permit only of a glance at a few other great peaks in the panorama that we are so hastily surveying Let us pass at once from Boyle to Lavoisier, another immortal, one of the greatest among the founders of your science, often, indeed, called the creator of modern chemistry, but also one who made fundamental contributions to the theory of respiration. He mistakenly held that combustion occurs only in the lungs Thus, in the well-known joint memoir with the great mathematician Laplace, published in 1780, the conclusion is arrived at

> Respiration is therefore a combustion, slow, it is true, but otherwise perfectly similar to the combustion of charcoal. It takes place in the interior of the lungs without giving rise to sensible light because the matter of the fire (the caloric), as soon as it is set free, is forthwith absorbed by the humidity of these organs. The heat developed by this combustion is communicated to the blood which is traversing the lungs, and from the lungs is distributed over the whole animal system (Foster's translation)

In spite, however, that the place where oxidation occurs is erroneously inferred to be in the lungs only rather than in the hidden recesses of the tissues of the body, Lavoisier is nevertheless the first chemist or physiologist to *prove* that the respiration exchange is the result of a combustion and he was the first to make quantitative measurements during respiration of the intake of the "respirable part" of the atmosphere (the oxygen of Scheele and Priestley, later so named by Lavoisier) and of the output of the "aeriform calcic acid" (the carbon dioxide or "fixed air" of Black) It is quite comprehensible that the creator of gravimetric analysis and the discoverer of the principle of the conservation of mass in chemical operations should have made this quantitative experiment in animal physiology

There is not time while we are on this subject of the respiration to consider the work of Joseph Black, Robert Hooke, Richard Lower and others of that time. The physician-chemist John Mayow (1643–79), however, can not be passed over without a word Like Boyle, Mayow saw clearly that respiration is supported, not by the air as a whole "but by the more active and subtle part of it, the spiritus nitro-aerius," or spiritus igneo-aerius, and both by experiment and inference demonstrated the analogy between respiration and combustion The increase of weight attending the calcination of metals he declares also as due to the absorption of the *spiritus* of the air. Mayow had sound notions in regard to the relation between increased muscular work and increased respiration a full century before Lavoisier and Priestley, but unfortunately, in conformity with the conceptions of his day, he states that his nitro-aerial spirit is separated from the blood in the ventricles of the brain and passes thence in supposed nerve tubules to the muscles where it combines with "sulphur," in consequence of which union muscular contraction results. The numerous and ingenious experiments of Priestley (1733–1804), one of the last

phlogistonists, on respiration, combustion and calcination, as detailed in his memorable treatise, Experiments and Observations on Different Kinds of Air (1774), must also be passed over.

The latter part of the eighteenth and the first quarter of the nineteenth century were days of great discoveries of inestimable value to mankind, discoveries that inevitably and finally raised chemistry to the status of a great science, a younger sister of physics, though in our day the exponents of the older science claim, and perhaps justly so, that your science will ultimately be incorporated into the body of physics and that instead of atomists you will become mathematical energeticists, dealing primarily with protons and electrons and quanta and other concepts of their wizardry.

In this period the elemental or composite character of the various "airs" that had so puzzled the men of Boyle's day was determined oxygen, nitrogen, hydrogen, methane and the composition of water and carbon dioxide came to be known The chemical balance came into daily use New elements were discovered and new inorganic compounds were made An increasingly large number of organic compounds were being isolated as definite chemical individuals from a variety of vegetable products and from the tissues and secretions of man and animals. In this period falls the discovery and isolation of some very important products of animal metabolism, as urea (1773), uric acid (1776), allantoin (1800), cystine (1810), creatine (1835), glycerin (1779) and other chemical principles, the study of which was later to exert so great an influence on the development of synthetic chemistry In this period also the pharmacist-chemists isolated quinine from the cinchona bark, that beneficient febrifuge (*Pulvis febrifugus orbis americani*) introduced into Europe from the new world nearly two centuries before; that gift of the gods, the juice of the poppy, was made to yield in crystalline form its analgesic morphine and its less valuable sister alkaloid, codeine (1803–1823) The seeds of the strychnos tree yielded up strychnine and brucine, hellebore and cevadilla seeds, veratrine, ipecacuanha, emetine; tobacco, nicotine; and a little later atropine was isolated from belladonna A discovery of fundamental importance for chemistry, medicine and the arts was Faraday's isolation of benzene from gas distillation residues in 1825 Of his "bicarburet of hydrogen," by which name the new hydrocarbon was designated, Thorpe wrote a quarter of a century ago: "the work which has accumulated around this single substance during the 75 years which have elapsed since it has been known constitutes one of the most astonishing records of intellectual and industrial activity of which history has any record."

But the first quarter of the nineteenth century was a period when men did not solely occupy themselves with the isolation of elements and new compounds but, as in the quarter of a century that we have just lived through, minds of a high order also developed theoretical principles Years after the enunciation of Boyle's Law and more or less coincidently with a host of brilliant discoveries of the very greatest importance in various departments of physics and in applied mathematics appeared Avogadro's law and Dalton's atomic theory I need only recall to your minds the names of some of the greatest investigators in physics of this era, as Faraday, Ampère, "the Napoleon of electricity," Oersted, Ohm, and preceding them, Galvani, Volta and Coulomb among those who laid the foundations of electro-dynamics; of Thomas Young and Fresnel in the field of light, of the great Carnot and of Fourier in that of heat, of Gay-Lussac and Mariotte in the field of the gases, of Dulong and Petit, who showed that the atoms of elementary substances have the same capacity for heat The important discovery that substances having an identical elementary composition may yet differ in their chemical or physical properties or both —isomerism—also falls in this period (1823), as also the enunciation by Grotthus (1818) of the fundamental principle underlying all chemical processes involving the absorption of light energy It was indeed a remarkable period Science and biology have been benefited as much or even more in consequence of these discoveries in physics of a century ago than by the chemical additions to knowledge that were coincidently made.

The formulation of such general statements capable of mathematical treatment is, as is known to all, the highest aim and the ultimate goal of the scientist's activity We, who deal with the chemical and physical complexities of living organs, where the variables are not only very numerous but also where the dependence of each of these variables on one or more of the others must be taken into account, can but regard the full attainment of these highest aims of biological science as something that lies in the far future.

It should be stated, however, that many special topics in the broad field of plant and animal physiology are already capable of quantitative treatment, and many of my colleagues will feel that I have understated our case. They will call to mind investigations in relation to vision, muscle contraction, the nature of the nerve impulses, the neutrality mechanism, respiration and metabolism, to cite only a few examples from physiology to which quantitative methods are applicable.

But let us trace still further the relationship between chemistry, biology and medicine The character of this relationship is now becoming reversed. No longer are the devotees of the biological and medical sciences foster-parents or foster-brothers of yours as in the old days It is we who are now dependent in a large part of our work upon you and your fellow scientists, the physicists

The reason for this change in relationship is not far to seek It lies primarily, as stated above, in the fact that your science has devised many more diverse and accurate methods of measurement.

THE ERA OF CHEMICAL SYNTHESIS

Hardly had the first quarter of the nineteenth century passed when new developments arose, more especially in organic chemistry, that were destined to push forward in an immeasurable degree not only man's ultimate conquest of nature but also his ability to control or conquer disease and to prolong life, and hence, in so far as this may contribute to that end, to increase the sum of human happiness The new era that has brought priceless gifts to mankind is the era of chemical synthesis In conformity with my plan of emphasizing the importance, for the biological sciences and medicine, of only the great achievements of your science in this era I must limit myself to a brief survey of the discoveries of a few among the great men whose work happens to be of especial significance for these sciences Let me begin with Liebig, whose contacts with medicine came through pharmacy, to which profession he was apprenticed in his early youth, and who later continued his chemical studies in Paris under Gay-Lussac In his "Organic Chemistry in its Applications to Physiology and Pathology," published in 1842, after stating that "the great physicians who lived toward the end of the seventeenth century were the founders of chemistry and the only philosophers acquainted with it," and deploring the fact that "modern chemistry, with all its discoveries, has performed but slender services for physiology and pathology," he gives expression to his belief that

> The most beautiful and elevated problem for the human intellect, the discovery of the laws of vitality, can not be resolved—nay, can not even be imagined—without an accurate knowledge of chemical forces of those forces which do not act at sensible distances, which are manifested in the same way as those ultimate causes by which the vital phenomena are determined, and which are invariably found active whenever dissimilar substances come into contact Before the time of Lavoisier, Scheele and Priestley, chemistry was not more closely related to physics than she is now to physiology At the present day chemistry is so fused, as it were, into physics that it would be a difficult matter to draw the line between them distinctly. The connection between chemistry and physiology is the same and in another century it will be found impossible to separate them

After this confession of faith by Liebig we can no longer wonder that this great chemist concerned himself during many fruitful years with numberless questions touching the life processes of plants and animals; that he should be remembered to-day not only for his lasting achievements in organic and in technical chemistry, for having been a great teacher and inspirer of young men, but also as the founder of agricultural chemistry and as the most notable among the modern founders of biological chemistry since Lavoisier

You all know that to the beautiful friendship which existed between him and the great Wöhler, unique in the history of science, and to the fortunate collaboration of the two in research, we owe some of the very greatest contributions ever made to the subjects now under consideration Friedrich Wöhler studied medicine as a young man, taking his degree in medicine and surgery at Heidelberg in September, 1823 While a lad at the Gymnasium, he devoted himself passionately to chemical experimentation and to the collection and study of mineralogical specimens, much to the neglect of his school subjects. At Heidelberg he came into close contact with the chemist Gmelin and with the physiologist Tiedemann. Before he had taken his degree the young Wöhler had already completed four investigations dealing with selenium and with cyanic compounds and the year (1824) after his graduation he published a very comprehensive study, originally intended for a graduation thesis, of the excretion in the urine of a very large number of substances, including iodine, carbonates of the alkalis, saltpeter and other inorganic compounds, numerous organic acids, including benzoic acid, substances that color the urine, as indigo and rhubarb, and such as impart an odor to this secretion, as turpentine and asparagus This paper, entitled "Experiments on the Passage of Substances into the Urine," was awarded a prize by the medical faculty of Heidelberg, and can be read to-day with profit by physiologists and pharmacologists, not alone for its numerous references to the work of other investigators of that time, but also because of the wonderful acumen with which the youthful investigator discusses the true function of the kidneys and the cause of the acidity of the urine He sums up his deductions in regard to the kidney in the following passage

> The kidneys are organs that serve the purpose of secreting a fluid composed in part of such substances as

pass in the unassimilated condition into the blood, being incapable of serving as replacers of bodily constituents, and in part of such as are produced during digestion and during the interchanges of material in the animal body (intermediary metabolism) or which are finally thrown off as being of no further use in these interchanges, they are therefore organs that serve to maintain the composition of the blood in a state necessary to the maintenance of life, without themselves producing any new substance whatever

Pharmacologists of a later day were to show that Wohler's "physiological deductions" needed to be modified in that the kidneys have a definite though limited power of synthesis and physiologists have also proved that, in addition to the kidneys, the respiratory function serves also to maintain the composition of the blood and tissue juices in the chemical equilibrium necessary to life

Fortunately for both medicine and chemistry, Liebig and Wohler in 1837 elected to attack the problem of the chemical constitution of that important metabolite, uric acid, first isolated by Scheele from urinary calculi in 1776, which up to that time had been of interest only to medical investigators and practitioners because of its connection with gout As A W Hofmann so aptly remarks, this constituent of our body has shown itself to be a very protean among organic chemicals.

The results obtained by these two great investigators in their study of this acid and of the more than sixteen entirely new derivatives which they were able to prepare from it, as also of the many previously known substances that were encountered by them during their oxidation and reduction experiments in this field, have been described in detail by A W Hofmann and have also been outlined in a fascinating manner by T E Thorpe in his essays on historical chemistry These memorable researches on uric acid excited the highest admiration of the chemists of the day, and I need not comment further on their significance for organic chemistry or for the future development of chemical physiology

I need not comment either at length on the great consequences for organic chemistry and for medicine that flowed from the collaboration of the pair in their researches on the nature of the oil of bitter almonds, suggested by Wöhler to Liebig in 1832 as a suitable subject for a joint research It must have been something akin to inspiration, says Thorpe, that led Wöhler to suggest the subject. I have often wondered whether the germ of the idea could not be traced to Wöhler's wide knowledge of medicinal substances Oil of bitter almonds had long been in use as a domestic remedy, and Wöhler, who, in addition to his professorship at Göttingen, also held the post of supervisor of pharmacies for the Kingdom of Hanover, must have been well aware of the medicinal properties of the oil. The discovery of the compound radical benzoyl (and of benzoyl chloride) and the proof that numerous correlated bodies could be grouped around it were epoch-making in their far-reaching consequences and will always remain, historians of science are agreed, one of the greatest achievements in organic chemistry

Wohler's discovery in 1842, made also independently by Alexander Ure, of Edinburgh, in 1841, that ingested benzoic acid is paired in the animal organism with glycocoll, or amino-acetic acid, and excreted as hippuric acid, which, from a purely chemical point of view, may be regarded as only a minor addition to the "benzoyl" edifice, became nevertheless of the greatest significance for physiology and pharmacology as constituting the first demonstration that the animal organism has the power to combine chemically dissimilar substances into new compounds—a capacity for synthesis that up to that time was believed to be confined solely to plants This discovery naturally led to wider views in respect to the nature of intermediary metabolic processes. Since 1842, biochemists and pharmacologists have discovered innumerable other instances of the very considerable synthetic power with which animal tissues are endowed and the conception no longer excites wonder by its novelty

The significance of Wohler's discovery in 1828 of the artificial formation of urea by the molecular transformation of ammonium cyanate is known to every freshman in our schools of chemistry and medicine. This discovery, the significance of which was fully realized by the young Wohler, effected a revolution in the ideas of men and showed that the organic substances present in bodies of animals and in plants can not be the products of a mysterious vital force but are subject to the same laws as those that are encountered by the chemist in his laboratory while occupying himself with bodies of purely inorganic origin

Of the chemists of the period under consideration who were intensely interested in the chemical phenomena presented by plants and animals, I can refer here only to the great French chemist, Jean Baptiste André Dumas, the contemporary of Wohler and Liebig. At the age of eighteen, the young pharmacist detected the presence of the newly discovered iodine in burnt sponge, a substance employed at the time in treatment of goiter, and later worked in conjunction with the physiologist Prévost on the active principle of digitalis, on the transfusion of blood, on the seat of formation of urea in the body, on the chemical changes accompanying the embryonic development of

the chick and many other chemico-physiological questions Naturally, even a man of Dumas's ability could not, at that time, make any significant advance in our knowledge in his too brief excursions into these difficult fields He and Prévost were, however, the first, as far as I am aware, to demonstrate by experiments on nephrectomized animals that urea is not formed in our kidneys but elsewhere in the system, as they were still able to detect it in the blood of the nephrectomized animals

In his later years, long after he had won his place among the great chemists of his time, Dumas returned, says Thorpe, to many of the chemico-physiological problems with which, in association with Prévost, he had begun his career as an investigator In this later period fall his studies with Boussaingault on the formation of fat in the animal body and his own studies on the origin of bees'-wax He proved that bees, even when fed exclusively on sugar, still retained the power of producing wax, contrary to the opinion of his predecessors, who believed that the bee secretes the wax while extracting the honey from flowers and that there is no necessary connection between the two processes The nature of alcoholic fermentation and the treatment of the silkworm disease induced by *Phylloxera vastatrix* were among the later interests in the life of this gifted and many-sided man

Having unfortunately little leisure for the pursuit of historical studies, I am fully conscious of the fact that I have given you a very sketchy outline of the points of contact between chemistry and medicine from Paracelsus to the time of Liebig, Wohler and Dumas The problem of animal respiration we had left in the state in which it was formulated by Lavoisier But even after Spallanzani and others had shown early in the nineteenth century that consumption of oxygen takes place in the tissues themselves rather than in the blood, a true solution of the problem could not be arrived at without quantitative data in regard to the oxygen and carbon dioxide content of both arterial and venous blood. Here a non-medical investigator, Gustav Magnus, professor of physics at Berlin, came to the rescue of physiology in 1837 By means of the mercurial air pump he was able to liberate oxygen and carbon dioxide from both arterial and venous bloods and to show that the percentage of oxygen is greater in arterial blood while that of carbon dioxide is greater in venous blood. These determinations by Magnus were afterwards amplified by the physiologists Pflueger, Ludwig and his pupils, among whom was Lothar Meyer, later to win distinction in pure chemistry, and their work, in conjunction with the labors of many other investigators during the last half of the nineteenth century, has given us a theory of both internal and external respiration which the science of our day has only been able to expand but not to overthrow The historian Fielding H Garrison pithily remarks that "the development of the physiology of respiration from Borelli to Magnus was almost exclusively the work of three mathematicians, two physicists and five chemists"

In respect to the further developments in regard to both internal and external respiration, I can not do better than transcribe the concise description by one of your own guild, Professor W. Mansfield Clark:

> In all science there are few developments as beautiful as those which have given us the precise knowledge of the blood equilibria. There have been found a quantitative relation between the iron of the blood pigment and the oxygen combining capacity, quantitative data for the equilibria between partial oxygen tensions and degree of oxygen saturation of haemoglobin, preliminary data on the Donnan equilibrium between the oxygen carrying blood pigment, trapped within the semipermeable membrane of the red cell, and the plasma; exact relations for the bicarbonate equilibria of the plasma and the acid base properties of the oxygen carrier, the mechanisms for the maintenance of constant hydrogen ion concentration of the blood and the control of lung ventilation by the activation of a nerve center called the respiratory center Of this Haldane says, "A rise of 0 2 per cent or 1 5 mm in the CO_2 pressure of the alveolar air and arterial blood causes an increase of about 100 per cent in the resting alveolar ventilation The outstanding delicacy of the regulation of blood reaction is thus evident. No existing physical or chemical method of discriminating differences in reaction approaches in delicacy the physiological reaction"

The prophecy of Liebig has been realized In our day chemistry and physics have become fused into the very structure of the biological and medical sciences But despite the fact that chemists during the past seventy-five years have necessarily concerned themselves largely with the development of their science along inorganic, synthetic, physicochemical, quantitative and, in recent years, more and more along electrochemical and mathematical lines, they have nevertheless, as in earlier times, continued to take an interest in the chemistry of life processes. It would too greatly lengthen this paper to give even a brief outline of the hundreds of contributions that have been made by the chemists of all countries to biochemistry since 1860 or thereabouts.

An outstanding example or two of the contributions of chemists to biology from that time to ours must suffice. And here there naturally comes first to mind the name of Emil Fischer, one of the very greatest experimental chemists of all time, whose outstanding contributions toward the solution of the

most difficult and important among biochemical problems will always be looked upon with veneration by those who are conversant with the researches of this genius and have a first-hand knowledge of these difficult subjects His researches on the chemical structure of the sugars and on the very specific ferments that liberate them from their derivatives, and on the structure of the proteins and their primary and secondary cleavage products effected a revolution in our chemical concepts of these products of vital activity and opened up new vistas in regard to biochemical processes An analysis and a description of his monumental discoveries in regard to the members of the purine group and their allies, as found in both animals and plants, would carry us back to Scheele's discovery of uric acid in urinary calculi and then to a consideration of the earlier discoveries of his predecessors, Wohler, Liebig, Fourcroy, Grimaux, Baeyer, Strecker, Horbaczewski and others Suffice it to say that the contributions of Emil Fischer surpass in their ultimate significance for chemical physiology those ever made by any other man in the entire history of biological and medical science

By substitution, degradation and especially synthesis, he established the genetic relationship between uric acid, xanthine and hypoxanthine and their multitudinous substitution products and showed that they may all be considered as derived from a substance $C_5H_4N_4$, for which he proposed the name purine (from *purum* and *uricum*) and which, although purely hypothetical at the time, he afterwards succeeded in synthesizing. In the field of the sugars, with the aid of phenylhydrazine, which he himself had discovered at the very outset of his scientific career (1875), he was able to isolate in pure form not only the few then known natural monosaccharides, but a host of others whose existence he predicted from the van't Hoff theory of the asymmetric carbon atom and which he synthesized by the skillful application of a number of general reactions, and in this way established the structures and configurational relationships of this very important group of substances He also studied in detail and clarified the chemistry of the glucosides, their structure and spatial configurations and especially their behavior towards enzymes The ester method for the separation of amino acids which he devised enabled him to determine much more nearly quantitatively than had hitherto been possible the composition of the complex mixtures resulting from the hydrolysis of proteins, and led to the discovery of several still unknown amino acids in such mixtures. These amino acids he succeeded in condensing with each other in amide-like union to substances which he called peptides and which, as the number of the amino acid residues of which they were made up was increased, approached closer and closer in physical and chemical properties to the peptones obtained from natural products. Similarly, he found that the tannins are glucosides of ester-like combinations, "depsides" (from δέψειν, to tan), of phenolcarboxylic acids joined to each other through a phenolic hydroxyl group of the one and the carboxyl group of the other As in his protein work, after having determined the nature of the component units of the natural products, he synthesized numerous compounds more and more resembling these natural products in their chemical reactions and physical properties

As I am noting here more particularly the contributions of certain leaders among so-called pure chemists toward the elucidation of the chemical occurrences in living things, rather than those of biochemists, pharmacologists and physiologists, significant as these have been, it is only natural that I should refer to the work of Willstatter, A v Baeyer's distinguished pupil You are all familiar with the brilliant researches of this master and his pupils on the chemical nature of chlorophyll and with their success in isolating in crystalline form the chemical individuals that had originally been grouped under that comprehensive term It has been said that if it can be assumed that one thing is of more importance than others, then chlorophyll is undoubtedly the most important and the most indispensable of all things. The epigram contains a larger element of truth than is usually inherent in pithy sayings Certainly the chloroplast of the green leaf, one of the most wonderful of all chemical laboratories, activated, as it is, by the sun's radiations, taken into consideration with the chemical activities of the other plant physiological mechanisms, offers problems that challenge the highest skill of the chemist and bio-physicist And here in this broad field of photo-synthesis we find pure chemists, plant chemists and physicists combining forces in our day as never before, in the solution of problems of the greatest significance, both from a theoretical and a practical point of view

Willstätter and his collaborators, building on the foundations laid by earlier workers, Hoppe-Seyler, Gautier and others in the eighties of the last century, v. Nencki, Küster and others since 1900, have finally given us a clear picture of the chemical relationship that exists between haemoglobin, the respiratory pigment of our blood, and the assimilatory chlorophyll pigments of plants The relationship is of philosophical as well as bio-chemical interest Both classes of pigments have essentially a comparable structure, the

basic complex of each, called aetioporphyrin by Willstätter, being a compound consisting of four substituted pyrrole nuclei united through two carbon atoms The blood pigment contains iron and the plant pigment magnesium in combination, partly through normal and partly through secondary valences, with the nitrogen atoms of the pyrrole groups in the aetioporphyrin complex On degradation the two pigments yield the red, metal-free porphyrins which are broken down by oxidation into the anhydride or imide of haematinic acid and this by loss of carbon dioxide gives methylethylmaleinimide

A second field of the greatest importance to both plant and animal physiology which has been greatly advanced by Willstatter's researches is that of the enzymes or organic catalysts These products of vital activity, in contrast to inorganic catalysts, such as the acids, the various elements and metallic compounds employed in our laboratories, are so highly specific in their action that a particular biose, as milk sugar, cane or malt sugar, for example, is only capable of being hydrolyzed by a special enzyme, the only one, indeed, that is capable of effecting its hydrolysis By devising new and ingenious modifications of a method long employed in biochemistry, that of adsorption, this investigator has been able to separate from their mixtures, and to obtain in a high degree of purity, many enzymes and to differentiate, for example, two such closely related sugar-splitting enzymes as saccharase and maltase The skilful employment of metal hydroxide gels, more particularly the various structural modifications of aluminium hydroxide, enabled Willstätter to effect these extraordinary separations of enzymes from the various impurities and the activating and inhibiting substances that are always associated with them in the naturally occurring mixtures with which we have to deal The new methods may truly be described as selective adsorption methods, as has been done by Willstätter, and it is interesting to note, as he points out, that this selective adsorption is determined, not by the degree of dispersion or other physical state of the adsorbing compound, but rather by its chemical structure

The researches of a century have shown how very numerous are the specifically acting enzymes that are present wherever protoplasm functions, whether in single-celled organisms or in the more intricate structures of the higher plants and animals, and how varied are the chemical operations whose entire course, that is to say, whose rates of reaction and elaborated products are determined by these unique agents of vital activity Admittedly, the further elucidation by chemists of both the dynamics and the organic structural problems here presented will yield results of the greatest significance both for chemical science and for the better comprehension of the life processes. For your consideration as chemists, I shall conclude my remarks on this aspect of biochemistry by the citation of a passage from a recent address of Willstätter on "New Methods in Enzyme Research":

> Of the characteristics of enzymes only the structural chemical and probably also the stereochemical specificity are uninfluenced and constant. The sugar splitting enzymes show the strictest specificity in both respects, as regards chemical constitution and arrangement in space, the fat-splitting enzymes have a wider range of activity on structurally different, ester like substrates But they appear to be more finely differentiated in their stereo chemical specificity If we compare the lipases of the pancreas, the liver, the stomach and the fungi as to their action on the same racemic substrate we find all different from each other in their selective action, preferring, now in the one case, now in the other, the d or the l form, if only we use a sufficiently large number of the racemic esters, as, for example, of the mandelic acid group This configurational specificity can so far be considered as an enzyme constant Thus far there has been observed no case where the influence of foreign bodies determines the direction of the rotation of the preferred compound

Even a rapid survey of the many other fields in which chemists and biologists have an interest in common would transcend the limits that time and a consideration for your patience impose upon me There remain, for example, the problems that arise in connection with the nature of the oxidation and reduction processes that are carried out in our bodies at 37 5° C —problems that stand in the closest theoretical relationship to the efforts of your fellow chemists to explain the true mechanism of even the simplest of oxidations, as that of carbon monoxide to carbon dioxide. My personal interest in this most fundamental of biochemical problems stands in inverse ratio to my ability to treat it adequately, even were there time at my disposal to do so. Fortunately I can refer you to the concise and elegant outline of this subject that was given us in Baltimore two years ago by Professor Stieglitz in his Dohme lectures This field, I am happy to say, is being tilled intensively by the younger physical, organic and biochemists of the day The earlier experimental observations of pharmacologists and physiologists in respect to the influence of a change in the *milieu* on the oxidative capacity of cells are now receiving an interpretation more in accord with our newer conceptions and more capable of mathematical treatment Thus, W. Mansfield Clark, who has distinguished himself in this field, points out in one of his recent papers how intimately related are the oxidation-reduction systems and acid-base systems of the animal organism, and adds:

This has long been suspected to be a matter of profound importance in physiology, but it is believed that this (his) is the first systematic presentation among the numerous theoretical possibilities among the interrelated acid-base and oxidation reduction equilibrium states.

I have also no time to comment on the reasons that induce the pharmacologist to follow your investigations with an absorbing interest and with keen enthusiasm. Some of these reasons are found in the biochemical problems outlined above, the essential parts of which are woven into the very texture of his thought, if I may say so But quite aside from these more fundamental problems, there exists also a community of interests between us concerning the invaluable remedies with which chemists, working often in close cooperation with the pharmacologists, are enriching our *materia medica* Occasionally, alas, in their cooperation in this field, both parties have fallen into the very human error of exaggerating the practical importance of their discoveries and researches—which latter, indeed, are often too solely and too transiently utilitarian in purpose and in character to redound to the credit of either party to the transaction

In regard to the influence that our American predecessors and our own contemporaries in this country have had in shaping the future course of the biological and medical sciences I need not speak at length Your influence, direct and indirect, on these sciences can be traced in the pages of the admirable historical review of your activities during the past half century published in the Golden Jubilee Number of *The Journal of the American Chemical Society*, though evidently the biochemical implications of this half-century's work could not always be brought out by the writers of that volume As never before in our history, our younger biological and medical investigators are utilizing in their investigations the methods and principles of the various divisions of your science A study of the various chemical, biochemical, biological, pharmacological, physiological and experimental medical journals of the country will furnish conclusive evidence that our countrymen are making fine progress in the broad fields covered by these journals.

Physical Chemistry and Biology

I come now to a consideration of some special points of contact between the physical chemist and the biologist, quite apart from the numerous references that have already been made to such contacts in earlier passages of this lecture. These contacts are conditioned by the composition and structure of the living substance—protoplasm—and the multifarious units—the cells of plants and animals—to which the protoplasmic structures are confined. The cell doctrine, far-reaching in its influence upon medicine and biology, as finally formulated by Dutrochet, Schwann and Scheiden before the middle of the last century, is to be counted among the very greatest discoveries of that century, comparable in its consequences for biology to those that followed the acceptance of the atomic and molecular hypothesis in chemistry

The mysteries of life lie concealed in these units, individually of microscopic size only, and specialized in structure and function in the multicellular plants and animals Naturally, I can not here comment on the reasons that necessitate a minimum external surface area for a cell, nor can I consider the influence of cells upon one another, nor the inadequacy of the cell theory to cover satisfactorily all the facts of development, as is claimed by a few biologists The individual cell, wherever found, must be regarded as a congeries of minute, discrete chemical factories, standing in a possibly mobile spatial relationship to one another and working together in a beautifully harmonious manner Surfaces, internal and external, and surface energies are of paramount importance in these individual units of life, as they are also when the units are aggregated in a manner to produce areas astonishingly large in dimension The total internal surface of a given single cell, when the extensive colloidal interfaces, not to mention the limiting surfaces of the nuclei, nucleoli, chromosomes, plastids, zymogen granules, vacuoles or other microscopically determinable components, would, if computable, be found to be very large in comparison with that of its outer envelope These internal surfaces, or boundaries between contiguous phases, are the seats of all manner of changes and operations, not merely all such as are broadly described as physico-chemical in character (electric charges, etc), but I venture to assert that all those protoplasmic processes that are usually defined as purely chemical in character, that is to say, oxidations, reductions, syntheses, hydrolytic decompositions, etc, are likewise surface actions In the living cell, then, we have a system, the *microphysical* or *ultramicrophysical structure* of which differentiates it entirely from the systems of our test tubes and enables the cell to carry on all of its manifold processes at 37.5° C, more or less, as the case may be.

The labile oriented molecular arrangement in space and time of the surfaces of discontinuity of the phases of the various heterogeneous systems of the living cell and the constant interaction of these surfaces with sources of free energy of the environment, may account for the continued differentiations, apparently purposeful and directed, that characterize living things, as compared with the trend of non-living things toward less complex states. It may well be

that an increase in our knowledge of molecular mechanisms in both fields will prove that the difference in behavior of living organisms and matter devoid of life is, in the last analysis, one of degree and not of kind

I have said above that considerations of surface are of paramount importance in biology Nature has found a means of producing very large surfaces by the aggregation of countless cells, as in leaves, root tendrils, capillaries and innumerable other structures Krogh has calculated that if we suppose the total weight of a man's muscles to be 50 kilograms and his capillaries to number 2,000 per square millimeter of cross section, the total length of the capillaries of our muscles alone would be something like 100,000 kilometers, and their total surface 6,300 square meters Our lungs, when collapsed, are small organs, but in them are found 725,000,000, more or less, of little pockets or alveoli where our thin-walled capillaries exchange carbon dioxide for oxygen The total internal area of these lung terminals or alveoli is close to 100 square meters, enough for thirty suits of clothes, as Sir Arthur Shipley puts it in his valuable little book entitled "Life" The thin-walled capillaries of the lungs, one thousandth of a millimeter in wall thickness, make it possible for the slow process of diffusion to do the work necessary for the maintenance of life in less than the four seconds of each respiratory act And so everywhere throughout the body we find these enormously extensive areas of cell surfaces—mechanisms for effective adsorption, secretion and excretion in the unit of time

I can not close this outline of "contacts" without a few further words on the bearings of physical chemistry on physiology and medicine Every scientist of our day has learned that our countryman, J Willard Gibbs, a man of the highest genius, by his fundamental and profound researches first placed the theory of surface phenomena on a truly scientific basis and made it capable of statistical and thermodynamical treatment Since his day our knowledge of the actual molecular structure of the surfaces of both simple and heterogeneous systems has been greatly extended by scientists in this and in foreign countries —in this country by Langmuir, Harkins and others Now, for more than half a century, physiologists and pharmacologists have been impressed, by the nature of the problems they were facing, with the need of more accurate knowledge of the physicochemical and chemical occurrences at the interfaces and limiting membranes of living structures Naturally, their problems are bound up with questions involving adsorption and surface tension, colloidal sols and gels, the influence of the ever-varying chemical state of cell membranes, catalysis and related actions Pharmacologists have always been confronted by the physico-chemical difficulties encountered in their attempts to analyze and understand the effects of drugs, including the powerfully acting hormones of our body, on both unicellular organisms and on the more complex structures of the animal body. My collaborators and I, to give but one example, have encountered such difficulties in our attempts to explain the increased susceptibility of the central nervous system of frogs to certain dyestuffs (ordinarily harmless) when administered subsequently to certain, otherwise trivial, injuries which so greatly increase the permeability of the capillaries and the adsorptive power of the cells of the brain and spinal cord that the ordinarily harmless dyestuff now reaches such a concentration in these cells (as can be shown by color tests) that violent strychnine-like convulsions immediately follow.

Workers in the medical sciences, as in biology, are bound to profit greatly, if not at present, then later, by the newer revelations in regard to the molecular structure of surfaces, more particularly those of micro-heterogeneous systems They will agree with Professor Donnan when he gives expression to his conviction that "the newly recognized 'two-dimensional' molecular world and the new knowledge of the structure of this 'surface world' presents phenomena of molecular orientation of the highest importance for the understanding of great regions of natural phenomena." Even though physical chemists are at present in disagreement in respect to many points in connection with this "two-dimensional" molecular world, the biologist must greet with enthusiasm every new and undoubted fact here discovered and the future theoretical developments in relation to it, even though he may only imperfectly comprehend the latter.

I realize fully that it is not within my competence to speak authoritatively in regard to the contacts between physical chemistry and vital occurrences, but I can not forbear citing, as a conclusion to my remarks on this subject, a heartening passage from Professor Donnan's address "On the influence of J. Willard Gibbs on the science of physical chemistry":

> In physiology the power and value of thermodynamical methods have been fully recognized only in comparatively recent times. Perhaps after another century of research in this science there may come another Willard Gibbs, who will discover the fundamental equations of the living cell, where the unseen of the past seems to reach out and grip the future. But for that we shall require something more than linear differential equations

The biologist, having in mind the ambitious attempts of the iatro-physicists and the iatro-mathematicians of the seventeenth century, as Borelli and

others, to reduce physiology to physics and "to ornament and enrich it by mathematical demonstrations," and while not unmindful of the great value inherent in the contributions of these pioneers to haemodynamics and the mechanics of muscular movement, will feel, nevertheless, that the physical chemists of our day, like their mathematical predecessors three centuries ago, do not always take into account the complexities encountered in this laudable purpose of reducing life phenomena to fundamental equations It is not specialized mechanisms, as the muscle, the selective permeability of membranes or certain definite chemical and physico-chemical processes like those of the respiration, which are already capable of thermodynamical treatment, that offer difficulties to the realization of this laudable ambition, but the more general cytological problems of biology such as are encountered in the study of cellular processes as a whole, of cell organization into highly differentiated structures, and of development in general, together with the difficult problems of heredity, that will tax the power of the Gibbses of the future Or, consider the difficulties that will confront the mathematician of the future in his efforts to express the entire life processes and the reproductive powers of a single-celled organism only, as, say one of the paramoecia, in the form of valid general equations To the biologist, it must appear that not one Gibbs but perhaps a half dozen or more will be required and their genius will be able to achieve results of value only after many more quantitatively determined biological facts shall be at their disposal than is now the case. The writer is an optimist in regard to the mental powers of the elect of our species, but he can not but feel that a single century will hardly suffice for the realization of these hopes, which biologists in general cherish equally with physicists and chemists

J. J Abel

The Johns Hopkins University

(To be concluded)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

GRANTS IN AID OF RESEARCH, FOR 1928

The allotment of American Association grants for 1928, in aid of research, will occur next December and all applications to be considered in that allotment must be in the Washington office by December 1 While the amounts of these grants are never large, being usually for sums less than five hundred dollars, yet this annual allotment constitutes an important part of the work of the Association. It is intended that the grants to individuals shall be specially useful in making possible the completion of important pieces of research already begun or that they shall be the means of supplying special apparatus or facilities, in cases where adequate funds can not be secured elsewhere They are generally announced in January and the funds become immediately available A grant may be disbursed in a single sum or in suitable installments according to the wishes of the grantee. All undisbursed grants or undisbursed portions of grants revert to the treasury on October 1 of each year, unless special arrangements have been previously made with the permanent secretary's office to have them made available for the next fiscal year. It will be remembered that the official year of the association extends from October 1 to the following September 30

It is specially important that members of the association should be alert to the possibilities of these small grants and that the older members should give advice and suggestions to the younger members in this connection when occasion arises, to the end that the grants may be allotted to persons who will make the most of them and for projects that are of outstanding and pressing importance Applications for grants may be made at any time, but no allotments are made excepting at the time of the annual meeting of the association A special form of blank is now provided for applications Copies of the blank are to be had from the permanent secretary's office Each application should be supported by letters from at least two persons who are acquainted with both the applicant and the research project for which a grant is needed

All applications for grants are referred to the Committee on Grants for Research, which makes allotments in December of each year At the annual meeting the council makes an appropriation for grants allotted by the Committee on Grants Each applicant receives a notice in January, informing him whether or not his application has been favorably acted upon The permanent secretary acts as secretary of the Committee on Grants, but he is not a member of the committee and has no vote. The membership of the Committee on Grants for 1927 is as follows Dr. Aleš Hrdlička (for Psychology, Anthropology, Education, Economics), *chairman*; U. S National Museum, Washington, D C Dr B M Davis (for Botany); University of Michigan, Ann Arbor, Mich Dr. Joseph Erlanger (for Physiology); Washington University School of Medicine, St. Louis, Mo. Dr Nevin M Fenneman (for Geology); University of Cincinnati, Cincinnati, Ohio. Dr. L G Hoxton (for Physics), University of Virginia, University, Va. Dr Vernon Kellogg (for Zoology); National Research Council, Washington, D C. Dr W. Lash Miller (for Chemistry); University of Toronto, Toronto, Canada.

Dr. Oswald Veblen (for Mathematics), Princeton University, Princeton, N J

Each person receiving a grant for any year is expected to send to the permanent secretary's office a report on the grant project, this report to be in hand before December 1 The report shows what has been done during the year If the project has been completed the report may be final, otherwise a later report should be sent in A progress report should be sent each October or November until the final report is rendered In these reports grantees are expected to give references, with full citations, to any publications they have made on the grant project and reprints or copies of such publications should accompany the reports It is also expected that, in the publication of results partly or wholly secured by reason of a grant from the American Association, shall be included due acknowledgment of that aid. A suitable acknowledgment may have such form as this "Financial aid for the work here reported was received from the American Association for the Advancement of Science in the form of a grant for the year 1927." Apparatus purchased or constructed with funds from a grant was formerly held to be the property of the association, but it is now to be given by the grantee to his institution or laboratory, or is to be otherwise disposed of by him so as to be of further use in scientific research The final report on a grant should show what disposal has been made of such apparatus Any unused portion of a grant should be returned to the association

Burton E Livingston,
Permanent Secretary

ALBERT WILLIAM SMITH

Albert William Smith was born in Newark, Ohio, on October 4, 1862, and died in Cleveland on March 4, 1927 He attended the school of pharmacy of the University of Michigan, from 1883 to 1885, graduated from Case School of Applied Sciences in 1887, and received his doctor's degree in Zurich in 1891 Even before his absence in Europe he was a member of the instruction staff in Case School, and he resumed his connection with the faculty upon his return in 1891 His life's work has therefore been very especially associated with this community In 1897 he became professor of metallurgy, but upon Professor Mabery's retirement in 1911 he returned to the department of chemistry as professor of chemical engineering In these years he has guided many generations of students into careers of usefulness, and each graduate carried out with him a special measure of regard and affection

His time and experience he readily placed at the service of others He served on the commission which studied the problem of Cleveland's water supply and recommended the filtration system In the world war he was in the Chemical Warfare Service under the Bureau of Mines. He has for many years been consulting engineer and director of the Dow Chemical Company He belonged to and took an active interest in the proceedings of the American Chemical Society, the American Institute of Chemical Engineers and the American Institute of Mining and Metallurgical Engineers He was a member also of the American Association for the Advancement of Science

In the Cleveland Section of the American Chemical Society and its parent organization, the Cleveland Chemical Society, he played a prominent part. Always valuable in its councils and its activities, he was three times its chairman and has for a long time represented it as councilor in the national organization

To those who knew Professor Smith well and came within the sphere of his personal influence, there will always remain outstanding an impression of charm which graced and enhanced the value of his academic and scientific achievements His character was so gentle, so kindly, yet so strong withal, that his influence was doubly effective and the circle of his admirers included all with whom he dealt For his intimate contemporaries the void left by his loss will never be filled. It is pleasant to realize that the kindness and consideration which he measured out so generously to others found a rich return in the happiness of his family life and in the delightful relations which existed between him and his friends and associates

H. G

SCIENTIFIC EVENTS

RESEARCH FELLOWS OF THE LONDON ZOOLOGICAL SOCIETY

The Zoological Society has lost both its anatomical and its aquarium research fellows, and the posts will be filled before the end of the year. We learn from the London *Times* that on the death of Dr Sonntag in 1925, the council decided to transform the post into a research fellowship, tenable for a limited number of years, in the hope of securing ambitious young anatomists who would desire to devote themselves for two or three years to research on the rich material for comparative anatomy available in the Prosectorium, before passing to professional work at a medical school or university. It was arranged, moreover, to allow the anatomical fellow to combine his work at the Zoological Gardens with a certain amount of teaching at a London medical school, in order that he

might keep in touch with professors and students. Dr. John Beattie, a graduate in honors of the University of Belfast, was appointed from a number of candidates as the first anatomical fellow and was attached to University College as well as to the Gardens. During his tenure, which began with 1926, he has published a number of papers on vertebrate anatomy, and has now been appointed assistant professor of human anatomy in the University of Toronto

The Aquarium Research Fellowship was instituted the end of 1924 to give na opportunity for such investigations into the conditions of aquatic life as could be conducted in the aquarium, where a laboratory and research tanks had been provided It was decided that the first fellow should devote himself specially to the chemical and physical conditions in the aquarium plant, so as to lay a firm foundation for biological inquiries The first fellow, Dr F P Stowell, was a graduate in honors in chemistry of the University of Liverpool and began his work in the Gardens in 1925 He also has published a number of papers of great value not only to the management of the aquarium, but as additions to scientific knowledge His tenure of the fellowship would have ceased at the end of this year, but he has received an appointment as research chemist to a large manufactory and left at the beginning of this month to assume his new work It is intended that his successor in the fellowship should take up a biological line of investigation

THE VOLTA MEMORIAL FELLOWSHIP

THE Italy America Society announces that a fund of $25,000, the income from which will be applied each year to post-graduate work in an American university of an electrical engineer from Italy, has been established by individuals, associations and corporations in this country who are interested in electrical development The fund has been raised to mark the one hundredth anniversary of the death of Alessandro Volta, inaugurator of a new era in electricity

Volta's anniversary has been marked this year with a special program in connection with the International Exhibition at Lake Como, Italy, where announcement of the formation of the memorial fund in the United States was received with much enthusiasm. The student who will come to the United States will be selected competitively by the Associazione Elettrotecnia Italiana, which corresponds to the American Institute of Electrical Engineers. In the United States the administration of the fellowship is in the hands of the Italy America Society

Maurice A. Oudin, vice-president of the International General Electric Company and chairman of the memorial committee, has outlined the purposes of the fellowship as follows.

> The year 1927 marks the one hundredth anniversary of the death of Alessandro Volta, and we, a committee representing some of those interests which owe a debt to the discoveries of Volta, have established this annual fellowship to enable an Italian electrical engineer, a graduate from one of the leading polytechnic schools of Italy, to spend one year in the United States in study and research. With the advice and suggestions of competent persons, the fellow will devote one scholastic year to attending one of our schools of engineering, and will be given an opportunity to visit our principal plants He will return to Italy enriched by his American experience and better able to be useful in the electrical development of the country which gave birth to Volta

COMMITTEE ON THE COST OF MEDICAL CARE

A BULLETIN has been issued by the Conference on Economic Factors affecting the Organization of Medicine giving information regarding the purposes of its new committee—the committee on the cost of medical care which was organized last May in Washington.

The committee, which is to serve five years, has been assigned the following functions by the parent organization

> (1) To conduct an analysis of the problem of medical organization, particularly of its economic factors
>
> (2) To plan a series of researches on the basis of the proposed analysis, utilizing, as the committee may see fit, the outline of studies prepared by the Committee of Five appointed at a preliminary conference held in Washington April 1, 1926 These studies are to be assigned to various interested agencies and individuals, and they will be subsidized only when they can not be properly undertaken without financial aid.
>
> (3) To conduct a limited number of studies when it becomes evident that they can not be handled adequately by any existing agency
>
> (4) To arouse the interest of professional groups and the public in the facts regarding medical service as they become available, particularly in the results of the committee's studies The committee will promote discussion by medical, public health and economic agencies, arrange or encourage addresses before organizations of the "consuming public" and conduct various kinds of conferences The publication of articles in professional and popular journals will be provided, and reports on the committee's researches be issued

An executive committee of the committee on the cost of medical care has been appointed with power to increase its number to seven or nine members, the chairman being Professor C.-E. A. Winslow. J Shelton Horsley.

An annual budget of $40,000 has been adopted.

Of this amount a grant of $10,000 (announced at the time of the conference, May 17) has been made by the Twentieth Century Fund, subject to conditions which it is hoped may be met Since the conference, a grant of $15,000 has been received from the Milbank Memorial Fund

TRIBUTE TO PROFESSOR HENRY FAIRFIELD OSBORN

PROFESSOR HENRY FAIRFIELD OSBORN, president of the American Museum of Natural History and research professor of zoology in Columbia University, was the guest of honor at a reception in the Hall of Birds at the museum on September 29 The celebration was in honor of Dr Osborn's seventieth birthday, which occurred on August 8

As Professor Osborn was not to be in New York on that day, a subcommittee waited upon him at Garrison on July 28 to make the presentation of a Queen Anne cup and birthday greetings The cup was inscribed "To Henry Fairfield Osborn, master builder, upon the occasion of his seventieth birthday, August 8, 1927, from his friends" The greetings were signed by more than five hundred of Professor Osborn's colleagues and friends from all over the world, the signatures being inscribed on individual cards of vellum which were then assembled and mounted in an illuminated book

A total of $8,040 71 was raised for the gifts About $5,000 remained after their purchase, and this sum will be used for a Henry Fairfield Osborn seventieth birthday research fund in paleontology

The following is the text of the congratulatory address

On your seventieth birthday your colleagues and friends join to salute you, to congratulate you and to express their delight in finding you radiant in health and spirit, joyously carrying on your life work

We desire to thank you most heartily for your leadership in many fields Drawing around you in the American Museum of Natural History a staff of explorers and coworkers who are animated by your spirit and who gladly enroll under your banner, you have penetrated to the uttermost parts of the earth and have brought its natural history treasures to the museum To your unceasing labors, as curator of paleontology and as president, we owe the series of unique exhibition halls at the museum, where countless visitors pass before an impressive panorama of extinct life Thanks to your sympathetic understanding, the school children of New York and their teachers enjoy all the educational and emancipative opportunities of the Museum's School Service And in the near future the museum will also display still other imposing evidences of your constructive genius when the Roosevelt Memorial Hall and the Akeley African Hall take their places in the assemblage of buildings devoted to science and education.

We desire also to express our admiration of the creative, tireless spirit which, during a life crowded with administrative work, has produced a series of publications, covering many hundreds of titles and ranging from brief articles in *Natural History* to the great monographs on the titanotheres and the proboscideans, now in press

We congratulate you upon the many distinguished honors that the highest scientific tribunals of the world have awarded to you in recognition of your services to science. We join the great company of your readers in acknowledging our indebtedness for such classic works as "From the Greeks to Darwin," "The Origin and Evolution of Life," "The Age of Mammals" and "Men of the Old Stone Age"

Princeton University will not forget your services when in 1877 as co leader with your life long friend Professor W B Scott, you led the first Princeton expedition to the fossil fields of Wyoming, or when, after your return from your graduate studies at Cambridge University, you brought the Huxleyan gospel of comparative anatomy to your pupils

Columbia University has reason to remember the great part you played in planning and guiding the Department of Zoology in its formative period, nor will your old students, either of Princeton or of Columbia, ever forget what new worlds you opened to them and showed them how to enter

The New York Zoological Society owes to you thirty one years of brilliant service as chairman of the executive committee and later as its president

From many parts of the world, therefore, your friends unite to testify their appreciation of your services as a leader in biological science, in education and in the highest ideals of citizenship

We congratulate you again upon this unique record of service We delight in the admirable spirit of fairness, generosity, friendliness and comradeship which you have shown, not only to your colleagues but to the least of your assistants And we rejoice with your devoted wife and your sons, daughters and many grandchildren, that this seventieth birthday finds you with forces unimpaired, still planning, still building, under the inspiration of a dauntless optimism.

SCIENTIFIC NOTES AND NEWS

SVANTE ARRHENIUS, director of the Nobel Institute for Physical Chemistry at Stockholm, distinguished for his contributions to physical chemistry, died on October 2, aged sixty-eight years.

DR. WILHELM EINTHOVEN, professor of physiology at the University of Leyden, known for his work in cardiac physiology and for the invention of the string galvanometer, died on September 28, aged sixty-seven years Dr Einthoven was awarded the Nobel prize in medicine in 1924.

ON the occasion of the opening of the new Henry Herbert Wills physics laboratory at the University of

Bristol on October 21 by Sir Ernest Rutherford, the degree of doctor of science *honoris causa* will be conferred upon the following: Professor Max Born (Göttingen), Sir William Bragg (Royal Institution, London), Professor A S Eddington (Cambridge), Professor Alfred Fowler (Imperial College of Science and Technology, London), Professor P Langevin (Paris) and Sir Ernest Rutherford (Cambridge)

THE Reale Accademia dei Lincei has conferred its royal prize in mathematics on Professor Leonida Tonelli, of the University of Bologna. One of the prizes founded by the (Italian) Ministry of Public Instruction has been awarded to Professor Enea Bortolotti, of the Reale Liceo Artistico di Bologna

SIR CHARLES SHERRINGTON, of the University of Oxford, will address a special meeting of the section of neurology and psychiatry, New York Academy of Medicine, on the evening of October 25

ON August 15 a banquet was held by the Czechoslovak Academy of Agriculture in honor of its visiting honorary member, Dr L O Howard, of the U S Bureau of Entomology During the banquet, Professor Stoklasa, who acted as toastmaster, spoke in appreciation of Dr Howard's contributions to entomology.

AT the annual election of the Safety Congress, H E Niesz, Chicago, was chosen president and W H Cameron, Chicago, was reelected managing director The following vice-presidents were chosen E W Beck, New York, C E Hill, New York, Miller McClintock, Harvard University, C J Moore, Longmeadow, C E Pettibone, Boston, H A Reninger, Allentown, Pa, G E Sanford, Schenectady, N Y; A W Whiting, New York, and Professor C-E A Winslow, Yale University

DR. E H. VOLWILER has been elected chairman of the scientific division of the American Drug Manufacturers' Association

DR. LEA McI LUQUER has been appointed research associate in optical mineralogy at the American Museum of Natural History.

PROFESSOR S S. STEINBERG, head of the department of civil engineering at the University of Maryland, has resigned as assistant director of the highway research board of the National Research Council, in order to return to his duties at the university and to practice as consulting engineer on road and street construction.

ON September 1, a few months after reaching the age of seventy, Dr. F. S. Kedzie retired from the deanship of the division of applied science of the Michigan State College and became the college historian Dr Ernst A Bessey, head of the department of botany, has been made acting dean in Dr. Kedzie's place, still retaining the headship of the department of botany. Dr Kedzie as student and as instructor, assistant professor and professor of chemistry, then as president and later as dean has been connected with the Michigan State College for about fifty-three years

DR JAMES P CHAPIN, associate curator of birds in the American Museum of Natural History, returned on September 25, accompanied by De Witt L Sage, from Central Africa, where they spent eighteen months in the Ruwenzori mountain range and the Kivu, volcano west of the Congo River, collecting birds and small mammals

PROFESSOR GUSTAV ALEXANDER, of Vienna, has arrived in New York for a brief visit to American medical centers He will lecture on oto-neurology and on histo-pathology of the internal and middle ear

PROFESSOR F C KRAUSKOPF, of the University of Wisconsin, is on sabbatical leave this semester, which he is spending in studying the methods of teaching freshman chemistry at various institutions in California Professor E R Schierz, of the University of Wyoming, is filling the temporary vacancy occasioned by Dr Krauskopf's absence

DR ELMER LASH, of the U S Bureau of Animal Industry, who for several years was stationed in Washington, was transferred to Des Moines, Iowa, on September 6 Dr Lash will assist in the administration of tuberculosis work in the states of Iowa, Nebraska, Missouri, Minnesota, South Dakota and Kansas

IT is reported that Dr Alwin Mittasch, head chemist of the German dye trust and coinventor of synthetic methanol and coal hydrogenation improvements, is leaving for the United States, where he will devote some time to scientific study in collaboration with American industry

PROFESSOR R A LEHFELDT, professor of economics in the University of the Witwatersrand, Johannesburg, since 1917, and formerly professor of physics in East London College and also in the South African School of Mines and Technology, has died, aged fifty-nine years

THE "John Hampton Hale" research laboratory of the Royal Dental Hospital of London was opened on October 4, by Sir Walter Fletcher, F R S.

A LABORATORY for the breeding of beneficial parasites has been opened at Farnham Royal, Bucking-

hamshire, under the direction of the Imperial Bureau of Entomology.

At the meeting of the international executive committee of the World Power Conference in Cernobbio, on Lake Como, it was decided to hold the next conference in Germany in 1930 It also was decided to hold a sectional meeting in Tokio in 1929

The first South African Medical Congress, under the auspices of the Federal Council of the Medical Association of South Africa (British Medical Association), is to be held in Bloemfontein in the week beginning March 12, 1928

The Albert Merritt Billings Hospital and the Max Epstein Clinic of the University of Chicago Clinics, was opened to patients on October 3 Formal dedication of the clinics will be held on October 31 and November 1, when distinguished medical men of this country and Europe will be present Hospital and out-clinic service will be available for cases in general medicine, surgery, eye, ear, nose and throat, and neurology. The new building on the Midway of the Chicago Lying-In Hospital, affiliated with the university, will provide for obstetric cases at a later date. The Charles Gilman Smith Memorial Hospital, to be built soon, will care for contagious diseases, the Bobs Roberts Memorial Hospital for children, and the Gertrude Dunn Hicks Memorial for orthopedic surgery The Chicago Lying-In Hospital is now engaged in raising the last $400,000 of the one million dollars required for its funds, and gifts have already provided for the construction of the other hospitals

The Saint Paul Institute has bought for $250,000 the Merriam residence adjoining the capitol at Saint Paul, Minn, to house the museum that was formerly displayed in rooms of the City's Auditorium The second floor of the building is given to biology and the third floor to geology. The building stands in the center of a two and a half acre tract which is to be used for expansion of the museum in the future

The Massachusetts Institute of Technology has received a large addition to its library in the form of a gift of about 200 complete volumes on chemistry and several sets of chemical journals from Mrs Henry P Talbot, widow of the late dean of the institute.

A College of Fisheries is to be established in Halifax, affiliated with Dalhousie University The university will give a course in the fundamental sciences, while the Biological Board of Canada will treat of fishery subjects A government appropriation of $25,000 has been made toward the establishment of a marine laboratory to be located somewhere on the shores of Halifax Harbor, in all probability near the open sea

The Paris correspondent of the *Journal* of the American Medical Association reports that the Pasteur Institute has received a legacy of $800,000 from a French physician, Dr. René Marius Appert, of Paris, who died at the age of sixty-five at San Remo, on the Italian Riviera.

Arthur William Scott, M A, of St David's College, Lampeter, Cardiganshire, for fifty-five years Phillips professor of science there, who died on March 7, aged eighty-one years, has made the following bequests £7,000 to the University of Cambridge, the income to be applied for the furtherance of physical science in such manner as the authorities may determine, £500 to Trinity College, Dublin, for the general purposes thereof, £250 each to the British Association for the Advancement of Science, the Physical Society, London ("of which I am a Fellow"), the Institute of Physics, London ("of which I am a Foundation Fellow"), £1,000 to the Royal Society, the income to be applied for the advancement of the physical sciences And after these and other bequests the residue of the property as to one third to the University of Cambridge, the income therefrom to be applied for the furtherance of physical science, one third to the University of Oxford for like purposes, and one third to St Thomas's Hospital, London

By the will of Mrs. Lilian Horsford Farlow, of Cambridge, widow of the late Professor William G Farlow, of Harvard University, the income of a $20,000 bequest to Harvard is to be placed at the disposal of the curator of the Farlow Reference Library, to be used for the purchase of suitable books and periodicals on botany Mrs Farlow presented the library in the cryptogamic botanical herbarium to Harvard, prior to her death, as a memorial to her husband Another $5,000 is bequeathed to Harvard, to be used at the discretion of the curator of the library for the purchase of a collection of cryptogamic specimens to be added to the Farlow Herbarium A bequest of $10,000 to Radcliffe is to be added to the Lilian Horsford Farlow Fund previously established for the college library The sum of $10,000 is given to Wellesley College to be added to the sabbatical grants established by Mrs. Farlow's late father, Professor Eben Norton Horsford, of Harvard. During her life Mrs. Farlow presented Harvard with $50,000 in memory of her father, the money to be used for the general purposes of the chemical laboratory, where her father was engaged in research work for many years.

The Associated Press reports that advancement of the study of meteorology from the viewpoint of aviation is the purpose of a committee formed by the Daniel Guggenheim Fund for the promotion of

aeronautics The committee will make its headquarters in the Weather Bureau in Washington Its members are C. G. Rossby, representing the fund, Willis R Gregg, of the Weather Bureau; Major William R Blair, of the United States Army, Lieutenant F. W Reichelderfer, of the United States Navy, and Thomas H Chapman, of the Department of Commerce

PURCHASE of two additional areas for the New York State park system in the Finger Lakes region has been asked in a resolution addressed to the State Council of Parks by the Finger Lake Parks Commission The parks recommended are Stoney Brook Glen at Dansville and Red Jacket Park on Cayuga Lake, near Seneca Falls

INFORMATION received by the U S Department of Agriculture shows unusual interest on the part of state legislatures in making appropriations for the eradication of tuberculosis from domestic livestock. The appropriations made by the states, together with approximately $6,000,000 appropriated by the last United States Congress, make available for the ensuing year's work approximately $18,500,000 In addition to the appropriations, valuable new legislation, amending various state laws, is expected to hasten the work in a number of states This campaign for eradicating tuberculosis in domestic livestock made exceptional progress during the fiscal year ended June 30, 1927 Records of the Bureau of Animal Industry show that 347 counties have completed the necessary official tests and have qualified for recognition as tuberculosis-free areas. This number constitutes more than 11 per cent of the total number of counties in the United States In addition 945 counties were actively engaged in the area project at the beginning of the current fiscal year.

AT the Leeds meeting of the British Association, as we learn from *Nature*, the council reported two conferences called to consider the possibility of establishing a Science News Service. The essential condition for success of such a scheme was said to be that scientific societies and institutions themselves should desire its organization. In view of the lack of unanimity and of enthusiasm evinced at the two conferences, the committee appointed to indicate the ways in which this support might be given considers that no useful purpose would be served by communicating with the scientific societies. The opinion is expressed, however, that should sufficient funds be forthcoming for the establishment of a Science News Service, the council of the association—possibly in cooperation with the British Science Guild—might appropriately undertake the organization of the service.

UNIVERSITY professors from various European countries were present at a meeting held in the Kurhaus at Davos (Switzerland) in support of a scheme for founding, at Davos, an Alpine University of an international character for students in delicate health. It is stated that there are, in Europe alone, over 15,000 university students suffering from tuberculosis. It was decided to hold another conference at Celerina, in the Engadine

DATA available for 1926 to the health section of the League of Nations indicate that the birth rate in many countries continues to decrease, and is likely to continue to do so for a number of years. The area of low birth rate (between 17 and 20 per thousand) now includes almost the whole of northern, western and central Europe The birth rate is still between 35 and 40 in eastern Europe, it now is lower in Sweden and in England than in France

THE summary of progress of the geological survey of Great Britain and the Museum of Practical Geology for the year 1926 has been published. The board states that highly satisfactory progress was made during the year, both in field work and indoor work The resurvey of coalfield areas has been pressed forward energetically In most of the British coalfields revision of the six-inch maps is being carried on and 64 maps were published during the year, showing the latest geological information and in many cases accompanied by descriptive memoirs Efforts have been made to render geological drift mapping of greater assistance to agriculturists Concern is expressed by the board that for financial reasons no provision has been made in the estimates of the Office of Works for the erection of the new building for the Geological Survey and Museum at South Kensington They consider the erection of the new building at the earliest possible date essential to the adequate preservation and presentation of the records Geological investigations in the Yorkshire coalfield, the Surrey Downs and the Isle of Man and new methods of investigating deep structures by means of the Eotvos balance are among the matters dealt with in the appendices

INVESTIGATIONS covering Tennessee, Arkansas, Mississippi and Louisiana by Dr. Joseph Goldberger and Edgar Sydenstricker, under the auspices of the U. S Public Health Service, indicate an increase in pellagra due to causes related to the recent floods From the survey made, it was estimated that pellagra, during 1927, will cause from 2,300 to an estimated total of about 2,500 deaths, with from 45,000 to 50,000 cases, as compared with 1,020 deaths and 20,000

cases reported in 1924 In the course of the survey, these investigators visited Dyersburg and vicinity, Tenn ; Little Rock, Pine Bluff, Marked Tree and vicinities, Ark , Jackson, Greenwood and Indianola, Miss , and New Orleans, Baton Rouge, Alexandria and Monroe in Louisiana Conferences were held with state and local health officials, some of whom do not seem to have definite information concerning the pellagra situation The information obtained was therefore of a very general character with regard to some communities, and in at least one community, very definite The authorities are satisfied that in the places visited the incidence of pellagra is abnormally high

The Associated Press reported on August 23 that intense activity of Bogoslof island, a volcano peak in the Western Aleutian islands, which rose from the sea May 18, 1796, was reported by Henning Plaun, Danish consul in Seattle, recently, after completing a trading trip to Ust, Siberia He said the volcano appeared as though it would explode like a giant firecracker "We went within three miles of the island," Plaun said "The entire island seemed afire Smoke and steam was issuing from every part of the island, and many huge cracks could be seen Hundreds of sea-lions were in the water off the island roaring as if in protest to the burning of their home We could hear their roaring for six miles" Thousands of birds swarmed about the island The water was discolored and a strong smell of sulphur was in the air Cable advices from Dutch Harbor, Alaska, last month reported that Dr T A Jaggar, volcanologist from Hawaii, making an investigation for the United States Geological Survey, saw twenty large volcanoes in action in the Western Aleutian islands Dr Jaggar at that time expressed the opinion a new spell of intense activity resembling the eruptions of 1906 was in progress Both Bogoslof and Fire island, which arose nearby in 1883, have spasmodically erupted, being joined and separated several times by the rising and lowering of the bottom of the sea

The Société des Amis de l'Université de Paris, at its last general assembly, under the chairmanship of M Raymond Poincaré, decided to donate considerable sums to various laboratories M Paul Appell, honorary rector of the Académie de Paris, whose fiftieth anniversary as a scientific worker was recently celebrated, presented a gift for the purchase of books for the students' study hall. Several other gifts were made for special purposes. M. David Weil gave $4,000 to be applied to the cost of printing theses presented by candidates for the doctor's degree at the Faculté des sciences and the Faculté des lettres. This donation is important because some students are unable to complete their graduation requirements because of the high cost of printing The funds furnished for this purpose by the Institute de France, the central government and Madame la Marquise Arconati Visconti have been exhausted

A chemical exposition will be held at Turin under the auspices of and supported by the Italian Government The exposition will last six months and will be confined to the national industry in the case of chemical products, but will be international as regards machinery and apparatus for the chemical industry, the following types of which are to be exhibited. (a) Pulverization and mixing, sieving, heating ovens and industrial processes, filtering, evaporating, distillation, crystallization, sublimation, centrifugal machines, suction plants, compressors, vacuums lignification of gas, compressed gases, drums, etc (b) Combustion gassification (c) Containers (d) Refrigerators, ice machines and refrigerating machinery of all kinds.

The Danish Arctic explorer, Dr Lauge Koch, accompanied by the Cambridge geologist, Mr Harris, and the Danish geologist, M Rosenkrantz, have returned to Copenhagen on board the *Gustav Holm* from Scoresby Sound, the base for the scientific expedition which went to East Greenland in 1926 After an autumn reconnoitering trip as far as Mackenzie Bay, Dr Koch, with three Eskimos, left on February 22 on a sledge journey with dogs of over 1,550 miles to Denmark Harbor The journey was extremely difficult owing to heavy snow. The party reached Denmark Harbour on April 8, starting back the same day Mr Harris and M Rosenkrantz, who had remained at Scoresby Sound, collected eight tons of fossils, the largest Arctic collection ever brought home. Mr Harris collected fossilized palms from Greenland's tropical period and M Rosenkrantz especially animal fossils, including a particularly beautiful ammonite, a yard in diameter They also found large quantities of coal in easily workable layers, but no precious metals In the neighborhood of Scoresby Sound many active hot springs and inactive volcanoes of about the same age as those of Iceland were discovered.

UNIVERSITY AND EDUCATIONAL NOTES

It is announced that Trinity College, Connecticut, will construct a new laboratory for chemistry, at a cost of $350,000, as soon as plans for the building can be prepared

An engineering laboratory, to cost about $100,000, in addition to equipment, will be erected at Haverford

College during the next college year as a memorial to T. Allen Hilles, of Wilmington, Del, a graduate of the class of 1870

A CHECK for $50,000, the gift of Cyrus H K Curtis, of Philadelphia, to Milwaukee-Downer College has been presented to the board of trustees to be used for the equipment of the science building now under construction

DR HENRY SPENCER HOUGHTON has been appointed dean of the Medical School of the Iowa State University.

DR FREDERICK H HOWARD, professor of physiology at Williams College, has been appointed professor of physiology at the College of Physicians and Surgeons, Columbia University

AT the University of California, E O Essig has been appointed professor of entomology and entomologist of the Agricultural Experiment Station Dr Edwin C Van Dyke has been appointed professor of entomology

DR MATILDA MOLDENHAUER BROOKS, formerly associate biologist of the Hygienic Laboratory at Washington, D C, has been appointed research associate in biology at the University of California.

DR. THEODORE KOPPANYI, of the department of physiology of the University of Chicago, has been appointed assistant professor of pharmacology in the college of medicine at Syracuse University

PROMOTIONS in the department of chemistry of the University of Pittsburgh have been made as follows Drs H E Woodward, F Y Herron and J N Roche, from graduate assistant to instructor, in the department of physics, Dr Oswald Blackwood, from associate professor to professor, and Dr. Elmer Hutchisson, from instructor to assistant professor, in the department of botany, Dr. A B Wallgren, from assistant professor to associate professor

THE vacancy in the electrical engineering faculty of Case School of Applied Science, created by the death of Dr Huxley, will be filled by Dr P L. Hoover, research fellow in electrical engineering at Harvard University, who has been appointed assistant professor of electrical engineering

PROMOTIONS at Yale University include the following: Dr. Edwin H Lockwood, Robert Higgin professor of mechanical engineering; Dr James D. Trask, associate professor of pediatrics, Dr Willard B. Soper, associate clinical professor of medicine, Dr. Edwin J Fisher, assistant professor of chemistry, Dr. Sidney M Newhall, assistant professor of psychology, and Dr. Albert F. Hill, assistant professor of botany.

DISCUSSION AND CORRESPONDENCE

THE INFLUENCE OF ADRENAL EXTRACTS ON THE SURVIVAL PERIOD OF ADRENALECTOMIZED DOGS[1]

UNTIL it has been shown that any adrenal extracts whatever possess the power of definitely increasing the period of survival after removal of the adrenals, the assumption that the cortex produces a "hormone" (which might appropriately be termed interrenalin) must lack a foundation, and attempts to isolate and purify such a body can hardly be made with confidence. We have used extracts, made from dog's fresh adrenals with 0 9 per cent salt solution and glycerine The clear extracts were injected intravenously on alternate days. The injections produced no obvious ill effects.

The only criterion at present at our disposal to determine the efficacy of an extract is its effect on the survival period This is a very severe test because of the fact that all the important derangements which eventually lead to death must be neutralized by the substance If changes not of themselves causing death could be associated with the loss of the adrenals, it might be easier to obtain evidence of the existence in extracts of a body or bodies capable of preventing them.

It is obvious that in drawing conclusions as to the effect of any method of treatment upon the period of survival, it is essential to have a sufficiently large number of "control" animals We have accumulated more than a hundred control dogs, so that it may be said with confidence that we know the limits of the survival period in dogs doubly adrenalectomized and not subjected to any treatment Of course, this series of control animals is necessary and available for many other researches The majority of the animals lived about a week to 10 days, a good many less than a week About 8 per cent survived a fortnight or somewhat longer. The longest survival period was 16¼ days (one dog)

Among about 30 dogs treated with extracts, one lived into the 18th day, one into the 20th day, one into the 22nd day, one into the 23rd day, one into the 28th day, and one survived 78 days after removal of the second adrenal Nothing like those results were seen among the much larger number of control dogs. It is impossible to draw any other conclusion than that the extracts in some way prolonged the life of the animals in the absence of the adrenals The rest of the treated animals compared favorably with the controls as regards duration of survival. As the extracts injected into the different animals were often obtained from different adrenals, it is easily understood that their potency would vary

[1] From the H. K. Cushing Laboratory of Experimental Medicine, Western Reserve University.

There is no reason to suppose that the epinephrin, present in larger or smaller amount in the extracts, could have had any appreciable influence in prolonging life. No effect of this kind was observed when epinephrin equal to the maximum amount which could have been contained in the dose, given on the assumption that none of it had been destroyed, was injected. Much of the epinephrin was destroyed in making the extract.

J. M. ROGOFF
G. N. STEWART
WESTERN RESERVE UNIVERSITY

AN INQUIRY INTO THE MOTION OF DROPLETS OF JUICE EJECTED FROM AN ORANGE[1]

WHEN an orange is divided into hemispheres and eaten with a spoon, it has often been observed that droplets of the juice emerge and proceed with extraordinary rapidity and uncanny accuracy into the eye of the observer. The phenomenon is a subtle one and explanations which have been offered are conflicting, so that recently certain experiments have been undertaken with a view to its elucidation. Although much remains to be done, it is believed that the results obtained are of sufficient importance to warrant a preliminary report at this time.

Earlier observations in this field, rather sketchy perhaps, may be mentioned briefly. Adam[2] is recorded as saying "damn" violently at the breakfast table (with, of course, the inevitable remonstrance from Eve). This may be regarded as very precise evidence that the oranges of that epoch delivered their droplets with unerring aim. Although the conditions were not quite the same the fact was evidently well known to Atlanta[3] who dropped oranges (the Greek word is ωϱαμσε, wrongly interpreted by the commentators as "apple") in the path of her competitors in races, thereby removing them from the competition. More recently the Spanish Dons were wont to present oranges to their ladies with a view to rendering them incapable of choosing other partners. In the late war no doubt only the high visibility of oranges prevented them from being used in the most bitter offensives.

In the present experiments a large concave ladle, 2,000 karat, served as a source of energy. The crossed fields were impressed by a cuneiform magnet, the usual precautions being observed when adding the cracked ice. It was soon found absolutely necessary to apply a relativity correction. This was done, however, carefully in Latin so as not to injure any of the finer sensibilities, if there were such present.

The results of the measurements showed that the diameters of the droplets were of the order of 10^{-21} cm, which accounts for their being able to enter the smallest crevice of the eye. Their speeds varied over a considerable range, but on the whole were high, averaging about a tenth of the velocity of light. It was found that the droplets were attracted towards the eye with a force varying with the inverse seventh power of the distance. These facts are all seen to be but details bearing out the surprising frequency with which the droplets steer for the eye, and are best explained by an appeal to the 1st law, *i.e.*, the innate cussedness of inanimate things. An exhausting series of experiments developed the remarkable fact that the right hand invariably propels the droplets into the left eye. A little thought, however, indicated that this was so because the right hand didn't wish the left to know what it was doing.

It is hoped to present in a future paper a mathematical explanation based on the flirtation theory of Einwein and Drinkemoffski.

E. O. HULBURT
WASHINGTON, D. C.

[1] Read before the Royal Society of Sultry Yachtsmen.

[2] Eden "Scientific Papers," 1, 35 (6721 B. C.)

[3] Homer, Canto 7.

USE AND DISUSE IN THE CHROMOSOMES

THE writer expressed his theory of use and disuse in the chromosomes as an explanation of phylogenetic development in the article "Factors in Phylogenetic Development" in the May–June, 1927, number of the *American Naturalist*. Further study of the principles expressed in this paper has led to the conclusion that the uniformity of genes in the various parts of the body need not be limited to the coordinative forces of the organism, although coordination is an obvious essential to such uniformity.

Since the chromosome complex characteristic of the species persists in most cells of the body, it follows that most cells contain a great number of genes which find no expression within those cells. It seems improbable that the millions of genes in this category are entirely without effect in the expression of inherited characters.

The only logical interpretation of this condition is then that a given character is the product of certain genes not merely in the cells taking part in the expression of the character but throughout the body. According to this view the distribution and influence of genes are not coincident. The development of a cell may be due to the influence of a multitude of genes rather than of one or a few within itself, and consequently any increase in the functional capacity of a gene due to repeated use would be at the outset an attribute of all genes of that kind throughout the

body, primordial germ cells included, since they are subject to the coordinating mechanism of the organism.

On this basis there can be no possible question of the association of somatic characters with the germ-cells It has been shown that any character which has significance in evolution is already a part of the heritage at least to the extent that it is a product of inherited functional capacity responding to some condition within or without the organism If we are justified in the interpretation of the functions of genes here expressed, any change in functional capacity accruing from use or disuse is no less a part of the heritage.

A W LINDSEY

DENISON UNIVERSITY,
GRANVILLE, OHIO

TYPE CULTURES

A COMPLETE catalogue has been issued by the *American Type Culture Collection* This catalogue can be obtained upon request to the Curator, American Type Culture Collection, John McCormick Institute for Infectious Diseases, 637 S. Wood Street, Chicago, Illinois The collection now contains about 1,450 cultures including 256 fungi and 200 yeasts A charge is made for cultures to help defray the cost of maintaining the collection

L. A ROGERS
Chairman, Executive Committee

THE ORIGIN OF THE PRAIRIE

A PHENOMENON heretofore unsatisfactorily explained by scientists is the occurrence of the natural grasslands of the Middle West, particularly the extensive prairies of Illinois, Indiana and Iowa Though most of the theories advanced explain their existence altogether in terms of present physical conditions, I am convinced that rapid drainage prevailing at the time of their origin is a determining factor in their development.

It is generally agreed that lakes or marshes are destined in the course of time to become either forest or prairie. One of the factors which may determine which of these shall be the ultimate stage has not been reported. It has come to my observation that if lakes or marshes are drained quickly prairie develops, if drained slowly forest develops This relationship occurred to me after I had observed small ponds in Albemarle County in Piedmont, Virginia, for a period extending over twenty-five years One pond observed was that on my father's land near North Garden, Virginia, which was built in 1888 by filling the lower end of a ravine with dirt and pine brush. This ravine contained a small stream which rose at the foot of a forest made principally of poplars (*Populus balsamifera*), black locust (*Robinia*), white (*Quercus alba*), red (*Quercus rubra*) and black (*Quercus velutina*) oaks The pond, however, was more directly surrounded by a jack pine (*Pinus virginiana*) forest Black porters loam soil had been washed down into the pond from the forest mentioned first until there was a deposit of two and one half feet and the pond was then left two feet deep. In the summer of 1904 the dam of the North Garden Pond was broken by a storm The succeeding vegetation was grass, in which no seedling trees appeared. Though the dam was rebuilt in 1905, since then the pond has been neglected Due probably to slow leakage caused by crayfish, the water level of the dam has been gradually falling Following this gradual drainage, the exposed edges have been passing through the willow (*Salix nigra, Salix longifolia*) and cattail (*Typha*) into the pine (*Pinus virginiana*) stage without the intervention of grass

Another pond observed through a period of years was the Coles Pond on top of Green Mountain, 1,000 feet above sea-level, and surrounded by a virgin oak forest consisting mainly of white (*Quercus alba*) and black (*Quercus velutina*) oaks. The pond was made by an artificial mound of dirt between two hills. When I first saw this pond in 1901 it was covered with coarse grass Mr Butler, the manager of Stutsville (the name of the farm), informed me it was broken two years previously by the water after a thunder storm Mr Butler refilled the pond in the fall of 1901 Since then it has been gradually drained by seepage. Algae first appeared on the edges such as *Oscillatoria, Spirogyra, Oedogonium* and *Vacheria*, followed by mosses on the edge, but not sphagnum As the water level dropped, these were replaced in the following sequence cattail (*Typha*), bottombush (*Cephalanthus occidentalis*), black willow (*Salix nigra*), sand-bar willow (*Salix longifolia*), maple (*Acer saccharinum*), jack pine (*Pinus virginiana*), and at the present time the black oak (*Quercus velutina*), red oak (*Quercus rubra*), sassafras, *Vertifolium*, intermingled with wild grape (*Vitis vulpina*)

Recently, further study under Dr H C Cowles in the Chicago region has provided additional data. Prairies, for example, are developing to-day from Calumet Lake near Chicago Sedges are encroaching rapidly upon the bulrushes as the new soil is gradually raised higher and higher above the lake, and in turn the encroaching of grasses upon the sedges is resulting in a prairie. Skokie marsh and hog marsh are also undergoing transformation of this character. Sometimes with the prairie grasses are a number of

coarse xerophytic herbs, largely composites (*Silphium laciniatum, S terebenthinaceum, S integrifolium, Lepachys, Solidago rigida, Aster, Liatris*), with legumes (*Amorpha canescens*, Petalostemon, Melilotus, Baptisia), and Eryngium, Dodocatheon, Phlox and *Allium cernuum* These prairies are being formed from the basin of the former glacial Lake Chicago.

The formation of natural grass and forest regions in the Chicago region may be explained by a study of its glacial history. While the edge of the ice in the last advance was being melted back to the Valparaiso moraine and while it remained there, glacial water flowed off to the south From northern Illinois this found its way by various valleys to the Mississippi As the ice retreated farther to the northeast of the Valparaiso moraine, the depression between the ice front and the morainic ridge was flooded with the glacial water The Lake Chicago so formed gradually enlarged as the edge of the ice retreated Its waters rose until they reached a level of about sixty feet above the present surface of Lake Michigan

At this stage Stony Island was completely submerged When the outlet of Lake Chicago was lowered, it entered upon a second stage twenty feet below the first, but Stony Island was still under the water As the outlet was lowered further the lake level fell to the third stage (the Tolleston stage), which exposed the very top of Stony Island By the breaking of the waves a beach ridge was formed on top of the island and at this time the forest began its growth Then when the ice sheet melted away and an outlet was established by way of the St. Lawrence Valley, the old lake fell to the present level of Lake Michigan, and the surroundings of Stony Island became land These surroundings, rapidly drained, are to-day grassland, while Stony Island itself is practically covered with forest

I believe furthermore that the grasses in the prairies are not a climax stage, but that the forests are gradually encroaching upon them This process is very slow because the grass, when once firmly established, forms a mat which prevents the seeds of trees from getting into the soil and germinating There are conditions, however, which aid the forest seeds in securing a place in the grass-covered soil For example, disturbances of that mat are caused by man's digging or plowing, horses pawing the earth and erosion by running water If tree seeds once fall in such places they will germinate and if undisturbed will grow. This would explain the presence of trees, either in patches or scattered throughout an area once covered with grass Indeed, the savannah may be accounted for in such a manner.

The help of eroding forces in the formation of forest may be further shown by observation of sand dunes. Here the instability of the soil is preventing the grass from forming a mat, and forests are slowly encroaching upon the dunes, securing a foothold before a grass mat can be formed.

In view of the above observations, I am of the opinion that the natural prairies of the Middle West are due not to present physical conditions but to rapid drainage at the close of the ice age. Further I believe that the grass stage thus formed is not the climax, but that trees are slowly invading the prairie, being aided in their progress by erosive processes.

PHILIP M JONES
THE PENNSYLVANIA STATE COLLEGE

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE PREPARATION OF COPPER HYDROSOL AND ITS USE IN ELECTROPLATING OF GLASSWARE[1]

SOME time ago the author found it necessary to copper plate the bore of some capillary tubing For technical reasons, a basic layer of another metal or of graphite was undesirable, even had it been possible to apply the latter. Cathodal deposition was also out of the question

By employing hydrazine hydroxide as a reducing agent a suitable copper hydrosol was prepared Gutbier found hydrazine hydroxide in 1–4,000 dilution sufficient for formation of the blue gold hydrosol[2] but since copper is immediately below hydrogen in the electromotive table a much stronger solution was found necessary in this case

Method —An article to be plated is well cleaned—that process followed by Brashear in his silver plating method[3] should be satisfactory It is then placed in a receptacle of just sufficient diameter to accommodate it and covered with a 50 per cent aqueous solution of hydrazine hydroxide (It is not necessary to prepare this from the salt—it appears to keep indefinitely when placed in the dark. After some months there may be a faint odor of ammonia, but there is no appreciable reduction in concentration) To this is added, drop by drop and with constant vigorous shaking, a 5 per cent. solution of cupric sulphate until a deep golden suspension of colloidal copper is obtained. One or two drops of excess are then added and metallic copper is de-

[1] From The Hull Physiological Laboratories of The University of Chicago

[2] Gutbier, *Zeit. für Anorg. Chem* 1902

[3] Brashear, Miller's Laboratory Physics. Ginn & Co.

posited as a thin film upon the surface of the article and the walls of the container This film may serve as a support and conduction pathway for a subsequent layer of electrolytically deposited copper

The method finds some objection in the expense of the reducing agent employed

The reaction is simply the formation of cupric hydroxide and its immediate reduction by the excess of hydrazine

$$CuSO_4 \quad N_2H_4 2H_2O \quad Cu(OH)_2 \quad N_2H_6SO_4$$
$$2Cu(OH)_2 \quad N_2H_4 2H_2O \quad 2Cu \quad N_2 \quad 6H_2O$$

The rapidity of the reaction allows for the formation of a hydrosol which gradually precipitates due to the presence of the bivalent SO_4 ion. When a suspension of cupric hydroxide is used instead of the sulphate the precipitation is much slower

However, the same effect is obtained by addition of an alkali to the hydrazide of copper This substance, prepared by treatment of potassium hydrazine carbonate with dilute copper sulphate, is a blue, amorphous, insoluble powder, of empirical formula CuN_2H_6 It shows all the qualitative reactions of a hydrazide.

ROBERT D BARNARD

UNIVERSITY OF CHICAGO

SPECIAL ARTICLES

ON THE APPARENT LARGE DIAMETERS OF MOLECULES FOR DEACTIVATION BY COLLISION

A RECENT paper by Tolman, Yost and Dickinson[1], devoted mainly to a criticism of some of the underlying physical assumptions made by Fowler and Rideal[2] in a theoretical study dealing with the rate of maximum activation by collision for complex molecules, with particular reference to its application to velocities of gas reactions, takes up the question of the apparent large diameters for deactivation-collisions to which the latter theory seems to lead.

The purpose of this note, in addition to [illegible] two other observations, is to point out an err[illegible] or Tolman, Yost and Dickinson's calculation on [illegible] m In agreement with Fowler and Rideal they [illegible]s that the fraction of molecules possessing ene[illegible] w greater than ε_0 in a system containing N molec[illegible] y per c c. each molecule having s variables (coordinates or momenta) which contribute classical square terms to the internal energy, is

$$N_{act.} = N \frac{1}{\Gamma(\frac{1}{2}s)} \left(\frac{\varepsilon_0}{kT}\right)^{\frac{1}{2}s-1} e^{-\frac{\varepsilon_0}{kT}}$$

If the maximum possible rate of deactivation by collision with unactivated molecules is given by

$$Z_{deact} = 4\, N\, N_{act}\, \sigma^{*2} \sqrt{\frac{\pi kT}{m}}$$

and if the principle of microscopic equilibrium holds, the maximum possible rate of activation by collision with unactivated molecules according to these authors, is given by

$$Z_{act} = 4\, N^2 \sigma^{*2} \sqrt{\frac{\pi kT}{m}} \frac{1}{\Gamma(\frac{1}{2}s)} \left(\frac{\varepsilon_0}{kT}\right)^{\frac{1}{2}s-1} e^{-\frac{\varepsilon_0}{kT}}$$

σ^* being the mean diameter for a deactivation by collision ε_0 is connected with the heat of activation q in the Arrhenius expression by the relation

$$\varepsilon_0 = q + (\tfrac{1}{2}s - 1)kT$$

$s = 14$, $T = 300°K$, $Q = 24{,}700$ calories, $\frac{Q}{RT} = \frac{q}{kT} = 41\,5$, and $\frac{\varepsilon_0}{kT} = 47\,5$ By substitution one obtains for the rate of activation

$$Z_{act} = 4\, N^2 \sigma^{*2} \sqrt{\frac{\pi \times 8\,3 \times 10^7 \times 300}{108}} \left(\frac{1}{6!}\right)\left(47\,5\right)^6 e^{-6}\, e^{-\frac{Q}{RT}}$$

$$= 4\,25 \times 10^9 \sigma^{*2} N^2 e^{-\frac{Q}{RT}}$$

The rate of decomposition as found by Hirst and Rideal[3] is

$$2\,53 \times 10^{14}\, N\, e^{-\frac{Q}{RT}}$$

taking $N = 1\,615 \times 10^{18}$ molecules per c c at 0 05 mm Hg and 300°K and assuming equality in the two rates,

$$\sigma^* = 6\,07 \times 10^{-6} \text{ cm}$$

or about 15 times that to be expected from kinetic theory values Tolman, Yost and Dickinson's value for the same calculation is $4\,7 \times 10^{-4}$ cms or nearly 1,000 times greater than kinetic theory values. The difficulties they point out with respect to large diameters are thus greatly reduced in significance especially when we remember that several other cases of large effective radii are known MacNair[4] calculates the effective diameter of excited Cd atoms as 3×10^{-6} cms from observations on depolarization effects. By comparing the per cent of polarization of D_2 resonance radiation in sodium vapor at 10^{-6} mm pressure excited by polarized light, with that predicted by the Heisenberg theory, Datta[5] finds that the effective diameter of the colliding atoms is of the order of magnitude 10^{-4} cm or over 1,000 times the kinetic theory value Similarly Schütz[6] calculates the effective diameter of a collision between normal mercury atoms and mercury atoms in

[1] Proc. Nat Acad. of Sci. *13*, 188, 1927.

[2] Proc. Roy. Soc. *113*, 571, 1927.

[3] Proc Roy. Soc *109*, 526, 1925.

[4] Phys Rev. *29*, 677, 1927

[5] Zeit. f Physik *37*, 625, 1926.

[6] Zeit. f. Physik. *34*, 260, 1925

the 2^3P_1 state to be 8 times kinetic theory value Stuart[7] finds the effective radius of collisions between mercury atoms in the 2^3P_1 state with foreign gases to be 5.9×10^{-8} cm MacNair[4] concludes that the largest effective radii are observed in depolarizing influences of neighboring atoms. In cases of transfer of energy between atoms not quite in resonance smaller effective radii are observed while with totally dissimilar atoms colliding the effective radii are still less We would expect therefore that with N_2O_5 molecules in random distribution the effective radii would be somewhat larger than given by kinetic theory

I would like to point out, that while collisions between inactive molecules are not considered to occur any more frequently than is usual in kinetic theory, yet collisions between active and inactive molecules which cause a transfer of energy and which may result in deactivation, are observed to occur 50 to 66 times as often as is given by kinetic theory using data for the radii of normal and excited atoms (Schutz[6]) This indicates that the apparent abnormality in diameter for deactivation by collision can be accounted for by increased numbers of collisions. This point might bear consideration Now it must be observed that the deactivational diameter calculated in the above fashion, presumes 100 per cent. efficiency for deactivation collisions, an assumption to which I am unable to subscribe any more than to assume that every collision resulting in a certain degree of activity causes the molecule to decompose In a recent paper[8] I have shown that only one in 100,000 molecules of azo-methane which may be sufficiently activated, actually decomposes We are thus in a position to understand more readily that the large deactivational diameters are only apparent and not real Consider the reverse of the reaction:

$$A + B \rightleftarrows A_{act} + B_{inact}$$

If every collision resulted in the deactivation of A_{act}, then the effective target area or diameter would turn out to be quite large, but if we give a kinetic theory value to the diameter of A_{act} we may then calculate the efficiency of deactivation. Another way of looking at the same thing is to say that on ordinary kinetic theory, an efficient process would appear to have larger effective target areas than an inefficient process

BERNARD LEWIS
National Research Fellow
SCHOOL OF CHEMISTRY,
UNIVERSITY OF MINNESOTA.
MAY 15, 1927

[7] Zeit f Physik. *32*, 262, 1925
[8] Proc Nat Acad Sci *13*, 546, 1927

POLLEN STERILITY IN PEACHES

THE writer has previously reported[1] the pollen sterility of the J H Hale variety of peach, and in the *Proceedings* of the International Conference on Plant Sterilities is reported some results on the inheritance of sterilities. In the latter paper, it is stated that of 127 seedlings secured from open-pollinated blossoms of J H Hale, 42, or 33 per cent, were pollen sterile, judging by the appearance of the anthers and by germination tests.

In the spring of 1926, a number of seedlings resulting from controlled crosses, using J H Hale as the seed parent, have bloomed, and because of the interest in this subject the counts are given herewith

Parentage	Population	Bloomed	Sterile	Per cent.
J H Hale × 43215 (Elberta × Greensboro)	111	63	31	49.2
J H Hale × Marigold (Lola × Arp)	184	106	35	33.0
J H Hale × 271 (Slappey × Dewey)	132	120	0	0.0
J H Hale × 32 (Carman × Slappey)	193	178	0	0.0

Chinese Cling, which is pollen sterile, is probably the seed-parent of Elberta, and Elberta is probably the seed-parent of J. H. Hale. Greensboro and Carman are probably direct descendants from Chinese Cling and Lola and Slappey are probably indirect descendants Dewey is believed to be of another group or race, so this latter group or race is probably involved in the parentage of Slappey and possibly of Elberta.

It is interesting that in the above crosses where a seedling of Slappey parentage was used, no pollen sterile seedlings have, so far, occurred In the progeny of J. H. Hale × 43215 and J H Hale × Marigold, there is an apparent difference in the ability of the pollen parent to produce maleness in the progeny, but there remain enough seedlings which have not bloomed to overcome this difference, and the latter eventuality is altogether within the bounds of reason.

C H. CONNORS
NEW JERSEY AGRICULTURAL
EXPERIMENT STATION,
NEW BRUNSWICK, NEW JERSEY

[1] Connors, C H., "Fruit-setting on the J. H. Hale Peach in New Jersey Agricultural Experiment Stations," 43d Ann Rpt., p. 102, 1922

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CONTENTS

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JACQUES LOEB AND HIS PERIOD[1]

Jacques Loeb was born in Germany in 1859, within a few miles of Strasbourg, or in a region in which French and German culture had long mingled His forebears were among the intellectuals who during the persecutions attendant on the Inquisition were driven out of Portugal and compelled to seek asylum in a more liberal country. They migrated from Lisbon to Amsterdam, and in later and quieter times settled in Alsace Thus, along with an inheritance distinctly intellectual, Loeb profited by contact with one of the richest European cultures during his formative period The intellectual cosmopolitanism which moulded his growth into physical maturity served him well throughout his varied life He was easily at home in the sophisticated intellectual atmosphere of Europe and in the younger but rapidly developing intellectual atmosphere of the United States, where he passed the years from 1891 to 1924

The influence of the French environment on Loeb's mental growth is shown by the part the writings of Voltaire and the French encyclopedists played in it, and the influence of German surroundings is shown equally by the German *Gymnasium* and university training Loeb attended three German universities—Berlin, Strassburg and Würzburg It was at Strassburg and Wurzburg that he met the conditions which were to guide his subsequent scientific undertakings. But his emotions were profoundly stirred and his inclination toward humanitarianism was fed by the French philosophers, and he always looked to these writers as among the great intellectual and spiritual liberators of all time In his book, "The Organism as a Whole," published during the great war, his tormented mind returns to them in the search for an anchor and haven of hope. "This book is dedicated to that group of free thinkers, . ., who first dared to follow the consequences of a mechanistic science, . . ., to the rules of human conduct and thereby laid the foundations of that spirit of tolerance, justice, and gentleness which was the hope of our civilization . . .," until swept away by the great war.

But it was the advanced system of scientific training

[1] Based on an address made at the exercises held at the Marine Biological Laboratory, Woods Hole, Massachusetts, on August 4, 1927, in connection with the erection of a tablet to Jacques Loeb.

of the German university which emancipated Loeb intellectually by providing him with a foundation for his experimental studies Loeb entered upon his university career at a propitious time; the German laboratories were filled with eager investigators and their thought was dominated by many fundamental problems in physics, chemistry and biology For a person like Loeb this fortunate circumstance could not fail to yield a significant result. His natively strong, perspicacious, inquiring mind, already colored by the writings of the French philosophers and naturally tending away from superstition and metaphysical conceptions, readily found a resting place in the growing physico-chemical beliefs of the time

Loeb received the M D degree at Strassburg in 1884 To one looking backward in a desire to follow the story of his intellectual development it would seem natural that he should soon discover that it was not medicine as an art so much as medicine as a science to which his tastes turned Medicine has in the past served as the doorway leading into science for not a few conspicuous men through it passed Galileo, Gilbert, Young, Helmholtz, and in our day and country Ira Remsen Even during Loeb's novitiate, as it were, less than to-day was medicine to be counted among the objective experimental sciences But if experimental medicine, as such, was still woefully backward, physiology, that basic science of biology and medicine, had already made significant progress During Loeb's student days, Claude Bernard had just ceased his colossal labors and Johannes Müller had hardly more than completed his extraordinary career as leader and modernist in physiology, pathology and clinical medicine, and had left to extend his influence the brilliant pupils Helmholtz and du Bois-Reymond. Moreover Ludwig was already started on the remarkable undertaking to develop quantitative physical physiology which was to produce a generation of investigators and teachers in that field.

It was very good fortune which directed Loeb to Strassburg and a fortune doubtless connected with his Alsatian birth Into that French-German environment, the German government projected after 1870 a center of higher learning staffed by a group of brilliant investigators and teachers To the medical faculty it sent such men as Hoppe-Seyler, von Recklinghausen, Schmiedeberg, Naunyn and Goltz. These are names to conjure with in biological chemistry, pathology, pharmacology, medicine and physiology Loeb was attracted to Goltz, the pupil of Helmholtz, who was adding conspicuously to the then beginning knowledge of cardiac pressure, the mechanism of shock, functions of the semicircular canals, and the effects of excision of the brain and spinal cord in the frog and dog That the last-mentioned subject should be the one to claim Loeb's special interest is not perhaps remarkable in view of his philosophic prepossessions. It was at this time that Loeb experimented on the chain reflexes and overthrew Munk's thesis that the Rolandic area is composed of cellular "sensory spheres," by showing that the particular paralyses occasioned by each cortical excision are abolished as soon as the wound has healed. The interest in the centers of brain activity thus aroused was to be continued in his later investigation of tropisms with which he concerned himself at Naples, and which led him to substitute for the anthropomorphic conception of the responses of animals according to supposed desires directing voluntary effort, the operation of tropisms or physico-chemical attraction, on the basis of which there was to arise a mechanistic conception of comparative psychology.

At this point it is desirable to retrace a few steps in order to follow the particular events which were to influence so greatly Loeb's scientific development Like other discoverers in science, Loeb was the product of his period This central fact in his notable career will become increasingly evident as we proceed At the threshold of his life's work circumstances brought Loeb from Strassburg to Würzburg, to be the assistant of Fick, a pupil of Ludwig, then professor of physiology, whose contributions to knowledge in the domain of physical physiology are significant The investigation of such problems as the physiology of the irritable substances, dissipation of energy and heat production in muscle, as well as the publication of larger works on medical physics, would appear to be sufficient to have attracted the quantitatively minded student of physiology to this particular master.

But whatever the benefit derived from this connection, it was small compared with the rewards in store from the chance association with Sachs which it brought about. The association produced admiration and led to friendship as well as to an impulse of direction in scientific pursuit which was to remain essentially fixed throughout Loeb's exceptionally rich and varied career It was the fortunate chance encounter with Sachs which turned Loeb's talents into the broad channel of general physiology Has not Claude Bernard[2] said that general physiology is the basic biological science toward which all others converge? Loeb was to find the truth of this axiom for himself and through his discoveries reveal it to a generation of investigators in a far distant land.

The botanist Sachs's personality and discoveries may be said to have dominated the field of plant

[2] Bernard, Claude, "An Introduction to the Study of Experimental Medicine," The Macmillan Co., 1927, p. 64.

physiology for more than thirty years, between 1857 and 1890, and his influence continues up to the present time. The physiology developed by Sachs was based on chemical and physical actions which he described under the term tropisms heliotropism, chemotropism, geotropism—or reactions to light, chemicals and gravity Loeb's alert mind grasped the significance of these phenomena, not only for plants but probably also for animals, so that we find him spending the winter months from 1889 to 1891 at the Naples Zoological Station, where the ideas he had formed could be subjected to experimental test. It was this period and under these particular circumstances that yielded Loeb's discoveries in the animal tropisms and in heteromorphosis

In a recent biographical sketch,[3] one of his distinguished pupils ascribes the studies leading to the idea of heteromorphosis to a desire on Loeb's part to combat the vitalistic conception of orderly animal development This purpose may well have had a part in the planning of the experiments, since at a later date Loeb became a warm antagonist of all mystical biological beliefs. Be this at it may, Loeb would seem to have been moved also by the conviction that the physico-chemical forces acting on living matter are one and the same, both for plants and animals. In other words, he applied by means of sharp, ingenious experiments the discoveries made by Sachs in plants to animals as well. Later Loeb extended the observations into the field of psychology and found them to hold there, so that he came to apply his deductions to the explanation of certain phenomena of animal behavior. This line of investigation would have been approved by Claude Bernard who wrote. "I am persuaded that the obstacles surrounding the experimental study of psychological phenomena are largely due to difficulties (associated properties) of this kind; for despite their marvelous character and the delicacy of their manifestations, I find it impossible not to include cerebral phenomena, like all other phenomena of living bodies, in the laws of scientific determinism[4]

Just as scientific men are made by their time, so extraordinary scientific men make their time what it is. Loeb is now definitely launched on his life's work which was, as far as was possible to him and with the knowledge available, to reduce biological appearances, the so-called manifestations of life, to the status of physico-chemical reactions. It is in connection with the investigation of the physico-chemical relations of vital phenomena that Loeb has exercised so great an influence on his generation. This is, of course, not the occasion on which to enter into a discussion of the controversy, not yet wholly adjusted, on vitalism *versus* determinism Early in Loeb's scientific career, far more so than at present, the nature of vital phenomena was a subject of eager debate. In this early period, the emancipation from mystical notions had not yet come to some great minds Was not Johannes Muller, the German colossus who bestrode all there was of medical science in his day and who was the master of Helmholtz, a confessed vitalist? He believed in the existence of something in vital processes which does not admit of mechanical expression; his strongly objective mind forced him, none the less, to hold that the mechanical explanation of physiological phenomena was to be pushed to the limit "so long as we keep to the solid ground of observation and experiment"

Fortunately, natural science had progressed further in France in the first half of the nineteenth century than in Germany The influence of the discoveries of chemists such as Dumas and Berthelot and of others penetrated into physiology The times brought forward the extraordinary figure of Claude Bernard, of whom Dumas said "He was no mere physiological experimenter, but physiology itself" Like Magendie and Johannes Müller, he made his bow to vitalism, but gave it the widest possible berth[5] Paul Bert, pupil and successor to his chair at the Sorbonne, said that, thanks to Claude Bernard, "the scientific method, respect for whose laws leads to certainty in the sciences of dead matter, assumed equal authority in the sciences of living beings." The stage was set for the new era in biology which was now to be established on the rapidly expanding sciences of physics and chemistry

A succession of remarkable men appeared and their accomplishments were destined to transform the outlook on the natural sciences. Thus, Loeb's generation of biologists was called upon to sustain a weight of investigative genius in physics and chemistry of hitherto unknown magnitude, and to his lasting credit Loeb was to perceive the trend of events and to sense the extraordinary influence which these sciences were to exert on physiology. Hence he threw his splendid talents into the study of biological phenomena along the lines of their physical and chemical activities, with results of which you are aware and which proved to be of the first importance for the subject of general physiology as now conceived. How great this weight of investigative influence was can

[3] Robertson, T. B., *Science Progress*, July, 1926–27, xxi, p. 114.

[4] Bernard, Claude, "An Introduction to the Study of Experimental Medicine," The Macmillan Co., 1927, p. 91

[5] Garrison, F H., "Introduction to the History of Medicine," Edition II, Philadelphia, 1917, p. 576.

best be seen from a tabulation, somewhat arbitrarily constructed, which I present The remarkable effect which the development of that composite science we call physical chemistry—a union of mathematics, physics and chemistry—was to exercise on biology and in the application of which to the interpretation of phenomena of living matter Loeb was an outstanding figure, is presaged in the fundamental discoveries of Gibbs, Pfeffer, van't Hoff, Ostwald, Arrhenius and J. J. Thomson, with whose period Loeb's is in immediate contact

Faraday	1791–1867
Liebig	1803–1873
Wohler	1800–1882
J Müller	1801–1858
Bernard	1813–1878
Ludwig	1816–1895
du Bois Reymond	1818–1896
Helmholtz	1821–1894
Virchow	1821–1902
Pasteur	1822–1895
Fick	1829–1901
Maxwell	1831–1879
Sachs	1832–1897
Goltz	1834–1902
Gibbs	1839–1903
Pfeffer	1845–1920
Emil Fischer	1852–1919
van 't Hoff	1852–1911
Ostwald	1853–
Ehrlich	1854–1915
J J Thomson	1856–
Arrhenius	1859–
Loeb	1859–1924
Nernst	1864–
Donnon	1870–
Einstein	1879–

It was characteristic of Loeb's agile mind that he should so surely and quickly catch the drift of thought and feeling, or the *Zeitgeist*, of the period and proceed to bend the new physico-chemical knowledge to the uses of physiology This was only repeating what he had already done with Sach's tropisms, and is something which fertile minds are always doing or striving to do A mathematician has told me that the growth of mathematics in the last fifty years made possible Einstein's calculations, which corrected and extended Newton's discoveries Taken all in all, physical chemistry constituted for Loeb the bright silver thread on which are strung the brilliant beads of his discoveries What the chief of these beads are may be read on the bronze tablet erected to-day to his imperishable memory "Brain Physiology; Tropisms; Regeneration, Antagonistic Salt Action; Duration of Life, Colloidal Behavior" A remarkable list truly of significant titles, and more remarkable even in that these complex phenomena should have been brought so largely within the definition of physico-chemical action.

* * * * *

Jacques Loeb has been among us so recently that many of us recall as of yesterday his vivid personality —his scholarly, slightly stooped figure, his noble head with strongly marked, reflective features, his thoughtful and somewhat pensive eyes, and the hearty, merry peal of laughter with which he lightened passing events of a world to him not always devoid of depressing moments and anxious thoughts

The man Loeb was the scientist, ever pursued by an inner demon demanding of him the solution of the next problem. It is of men like Loeb that Priestley said that each discovery shows many other discoveries that should be made, and Pascal invented the paradox that, "We are in search never of things, but of the search for things" Loeb gave himself no respite, each succeeding year he drove, if possible, with greater intensity toward a goal always being approached and yet always eluding Possessed of that vigorous quality of imagination which goes by the name of intuition or even inspiration, and which in essence consists of a feeling in the mind that amounts to a presentiment of truth, he was a remarkably fruitful inventor of ideas or hypotheses, the experimental verification of which is the chief means of extending scientific knowledge. His prescience reminds an associate of Faraday, because of Loeb's uncanny gift of knowing the truth before the experiment was made "I know what it is; the question is how to prove it"[6] The proof might be long in coming, but it would come and then the result would be startling Loeb's habit was to ponder, sometimes for years, chance findings, until the mode of attack of the problem appeared, and he then moved with precision and celerity. In this way fragmentary observations, partly his own and partly others, on artificial fertilization led to the discovery of its production at will, and artificial parthenogenesis was discovered.

Newton said that he made his discoveries "by always thinking unto them . till the first dawnings open slowly little by little into a full clear light" The power of long thought is something that goes with the highly original gift which we associate with genius Buffon said that genius is patience, and Newton attributed his discoveries to "nothing but industry and patient thought." Claude Bernard's definition is more searching: "Genius is revealed in a

[6] Northrop, J H, "Jacques Loeb—1859 to 1924," *Ind. Eng Chem.*, 1924, xvi, 818.

delicate feeling which correctly foresees the laws of natural phenomena, but this we must never forget, that correctness of feeling and fertility of idea can be established and proved only by experiment"[7] "Genius is patience? No, it is not quite that, or rather it is much more than that, but genius without patience is like fire without fuel—it will soon burn itself out"[8] Loeb possessed the patience and he had the industry, alas, his industry was in excess of his physical constitution, so that he burned out his life before he consumed his talents

In 1910 Loeb exchanged a professorship at the University of California for membership in The Rockefeller Institute for Medical Research He organized at the Rockefeller Institute the Division of General Physiology, the first department of the kind to be created in the United States It was fitting that Loeb, whose discoveries had so enriched general biological science, should have been the pioneer of general physiology in this country The growth of the new establishment was such that in 1918 a *Journal of General Physiology* was called for and Loeb undertook the task of founding and editing such a journal His removal to New York called for modification of the research program. As may be observed from his discoveries in the field of colloid chemistry, his fertile mind met the new conditions. By dividing the year between New York and Woods Hole, Loeb's working facilities were enlarged, and this happy arrangement filled his last years with scientific opportunity commensurate with his needs, sympathetic scientific association, and although grudgingly given with those recreative enjoyments which his intense nature required

Loeb was of the type of the intensive individual investigator, hence his immediate pupils are not numerous. But if Loeb's direct influence was reserved for a favored few, his wider influence has been shared by a large body of students and investigators and even by the educated lay public His personal contact with successive groups of scientific workers at Woods Hole, the Rockefeller Institute, and elsewhere has been of incalculable value. Loeb's profound scientific learning and experience, wide reading, liberal views often warmly expressed, vivid imagination widely dispensed, and his fund of sparkling wit made him at all times a stirring and delightful companion No one could have been kinder than Loeb in his human relations, and fortunate were those who came under the reign of his genial, many-sided personality. It is unhappily too true of him "that he may be succeeded, but can not be replaced"

[7] Bernard, Claude, "An Introduction to the Study of Experimental Medicine," The Macmillan Co., 1927, p 43.

[8] Lodge, Sir Oliver, "Pioneers of Science," London, The Macmillan Co., 1893, p. 202.

Jacques Loeb's life was spent in an ardent desire to interpret nature. It was peculiarly true of him, as has been said, that knowledge is at once the sole torment and the sole happiness He knew as few come to know the joy of discovery, which is one of the liveliest the mind of man can feel. He knew also, almost too well, that this joy of discovery, to which his inner demon impelled him, is no sooner found than lost, that it is but a flash, whose gleam discovers fresh horizons, toward which our insatiate curiosity repairs with still more ardor This is research the search for truth which, if never found in its wholeness, is yet secured in significant fragments, and these fragments of universal truth are precisely what constitutes science[9] To this search for fragments of universal truth in living matter Jacques Loeb devoted his great talents and his rich life.

SIMON FLEXNER

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH,
NEW YORK

CHEMISTRY IN RELATION TO BIOLOGY AND MEDICINE WITH ESPECIAL REFERENCE TO INSULIN AND OTHER HORMONES

II

ORGANS OF INTERNAL SECRETION

I may now be permitted to call your attention to a field of knowledge that has occupied experimenters for more than half a century—a field of great importance not only to the biologist in general, but to those who are associated in any way with medicine, as the bio-chemist, the physiologist, pharmacologist, the numerous representatives of the medical and surgical professions—a field that is concerned with a study of the functions, both normal and abnormal, of the organs of internal secretion. To the chemist is given a unique opportunity in this field and here, as is so often the case in biology, the last word is his. In saying this I have particularly in mind the obvious chemical aspects of the problems here presented, as, once they are cleared up, the physiologist and the physician are enabled to outline their own problems relating to the function of these organs with greater precision.

The significance of the interdependence of the various mechanisms of the animal body, of their admirably regulated activity and the harmonious manner in which these mechanisms cooperate in the development and growth of the individual from the moment when they first become apparent in early embryonic life to

[9] Bernard, Claude, "An Introduction to the Study of Experimental Medicine," The Macmillan Co., 1927, p. 222.

the time when we are returned to the dust from which we sprang has no doubt always been apparent to the mind of man, as is so well illustrated in Aesop's fable that it will not do for the various members of the body to fall out with each other The medicine of an older time has long used the words *consensus partium*, the mutual dependence on each other, in other words, this interrelationship, of the various organs Generally speaking, until about a century ago the *consensus partium* was supposed to be effected solely through the intermediation of the nervous system—a point of view tersely expressed in 1752 by the French anatomist Cuvier when he said "Le système nerveux est, au fond, tout l'animal, les autres systèmes ne sont là que pour le servir." According to this view, then, to put the matter in popular language, certain control stations in the brain and spinal cord and of the peripheral autonomic nervous system coordinate all the functional activities solely by means of telegraphic communication (though a nervous impulse is quite a different thing from an electric current) During the past seventy years, however, conjoined chemical and physiological discoveries have brought to light a new method of communication between organs and a coordination of their functional activities, closely linked, to be sure, with the longer known type of control but yet quite distinctly different To-day we also have, as Professor Starling so aptly put it, an efficient postal service at the disposal of the various mechanisms of our body The little packets of chemicals sent out by the organs of internal secretion are carried by the blood stream to their appointed destinations and are generally called hormones, the name given to them by Starling twenty years ago. The term is derived from the Greek verb ὁρμάω (I stir up or excite), and is perhaps less appropriate than the designation *chemical messenger*, earlier applied to this class of substances by the same physiologist

These chemical messengers may initiate changes in the functional state of a distant nerve cell or nerve terminal, or a series of chemical changes, or take part in some intermediary chemical reactions in a distant organ—reactions that may or may not have been initiated primarily by a preliminary nervous impulse or telegraphic message

The organs in which these chemical messengers are elaborated and from which they are despatched into the blood stream are known as organs of internal secretion, or endocrine organs Some of these are called ductless glands—structures that are entirely devoid of secretory ducts, as their name implies, and can only perform their functions by sending their chemical messengers into the blood and lymph, by which they are transmitted to the various organs of the body Examples of such ductless glands are the thyroid, the parathyroids, the pituitary organ and the intestinal mucosa. Examples of endocrine organs that play the double rôle of producing ferments or other chemical agents that are eliminated by special ducts or passages as well as chemical messengers that pass into the blood stream are the pancreas and the sex glands

The entire list of organs possessing an endocrine function need not be given here Let it suffice to say that additions to the list of chemical messengers are constantly being made as the conceptions in this department of physiology have broadened in consequence of more intensive experimentation Organs such as the heart, for example, have been shown to produce substances that influence the rate of its contractions by an action on its regulatory nervous mechanism The carbon dioxide that is excreted by our tissues as an end product of their metabolic activity acts as a hormone or regulator of the external respiratory apparatus In the widest and perhaps truest sense of the word, every tissue, as Schäfer remarks, is an internally secreting structure

Juice expressed from the embryonic heart of the chick contains a chemical substance, or perhaps more than one, that is indispensable for the continued growth, in the warm chamber, of an isolated fragment of an embryonic heart. This continued maintenance of life and growth in the thermostat of fragments of tissues excised from cold or warm blooded animals or from tumors was initiated by Ross G Harrison and is known as tissue culture Carrel has suggested the term "Trephones" (from γρέφω—I feed) for the growth-promoting substances of embryonic tissue juice and of leucocytic extracts I have called to your mind the work of Carrel and his associates on the artificial propagation of the fibroblasts taken from a fragment of the embryonic heart of the chick because the indispensable trephones or growth-producing substances that must constantly be added to the culture medium may properly be called hormones. They are produced in the cell laboratories of the chick's heart and function in some as yet unexplained manner as regulators of the complex intermediate chemical processes that are necessary to the orderly life of the cell. It will interest you in this connection to learn that Carrel and his collaborators have, from January, 1912, to June, 1927, carried a fragment of embryonic heart tissue through 2,987 generations or "passages of cultivation" There is no reason to doubt that this fragment of tissue would continue to develop indefinitely, provided only the temperature of the thermostat be maintained at 37.5° and that the composition of the nutritive medium remains constant. These extraordinary growth-promoting substances or cata-

lysts of the embryonic tissue (and of leucocytes) may for the present be classed with the hormones.

You are all aware that modern research has revealed the astonishing fact that we require for the complete nourishment of the body, in addition to the energy-yielding and mineral constituents of our food, minute quantities of other substances which are called vitamins. There are many analogies between the physiological properties of these vitamins, which may be called hormones of plant origin, and those that are produced in the animal organism.

According to many plant physiologists, chemical messengers appear to play an important, if not occasionally a greater, rôle in the life of plants than they do in that of animals, but as this phase of the subject lies outside the field of my own experimentation I shall content myself with having called it to your attention

I can not enter into the details of the story of the discovery of the functions of the ductless glands proper or of the endocrine functions of the organs that have both an external and an internal secretion The whole subject constitutes one of the greatest contributions of the nineteenth century to scientific medicine Osler in his "Evolution of Modern Medicine" gives it as his opinion that

> there is perhaps no more fascinating story in the history of science than that of the discovery of the so-called ductless glands . No such miracles have ever been wrought by physicians as those which we see in connection with the internal secretion of the thyroid gland The myth of bringing the dead back to life has been associated with the names of many great healers since the incident of Empedocles and Pantheia, but nowadays the dead in mind and the deformed in body may be restored by the touch of the magic wand of science The study of the interaction of these internal secretions, their influence upon development, upon mental processes and upon disorders of metabolism is likely to prove in the future of a benefit scarcely less remarkable than that which we have traced in the infectious diseases.

We are but at the beginnings of knowledge, especially as concerns the chemical and physiological problems that are presented in this great field. Consider, for example, that remarkable and still unknown hormone elaborated in the anterior lobe of the hypophysis and passing from thence into the blood In it we have a chemical agent that can affect the growth of bone and other structures to an extraordinary degree. The unchecked action of this growth-stimulating principle, extending over a period of years, leads to acromegaly or gigantism. Evans and Long, by injecting potent extracts of the anterior lobe of the hypophysis daily into young rats, have succeeded in producing veritable giants of their species. One typical experiment may be cited: a rat received intraperitoneally anterior hypophyseal substance for a period of 333 days At the end of that time the animal weighed 596 grams, while its healthy litter mate control weighed only 248 grams.

Studies of this nature have succeeded for the first time in throwing a bridge across the chasm that has hitherto separated bio-chemistry from morphology. Distinguished anatomists, indeed, as Sir Arthur Keith and Professor Bulk, of Amsterdam, have expressed their conviction that the differentiation of mankind into racial types is due to the differential interaction of these endocrine organs. The cumulative experience of a host of medical observers during the past seventy-five years has demonstrated beyond a doubt that innumerable departures from the normal in respect to bodily stature, facial configuration, sexuality, general metabolism and even the mentality find their explanation in the over- or under-activity of these, anatomically speaking often quite insignificant, structures, or in a lack of harmony in their cooperation. It is one of the tragedies of life, a decree of fate, that we should be both "the beneficiaries and the victims of the chemical activities and correlations of our endocrine organs."

Our chemical knowledge of the elusive principles, elaborated in minute quantities only by these indispensable organs, is in its infancy, as I have already intimated, and still lags far behind our acquaintance with their physiological actions Only two of them, substances of low molecular weight and relatively simple structure, have been prepared synthetically. In respect to these two, then, the organic chemist has again come to our rescue and both the experimentalist and the manufacturer are now free to accept their deliverance from the products of the slaughter house.

The first of these hormones to be conquered is the one that is elaborated in the so-called medulla of the suprarenal capsules, small yellowish structures, each shaped like a cocked hat and fitting snugly on top of its corresponding kidney. The two organs together, in a fully developed man, weigh less than a third of an ounce. Life is impossible without them Like some others of the endocrine organs, notably the hypophysis, they are double structures, fused in the higher animals into what is apparently only one organ consisting of a medullary or inner portion and a cortical or outer portion. This cortical portion contains a hormone, or hormones, more immediately necessary to life than that produced in the medulla. Investigators are now occupying themselves with it and we look forward, I confidently believe, to a successful outcome of their researches.

The medullary hormone is called by various names, as adrenin, suprarenalin, suprarenin, adrenalin and

epinephrine, the latter having been adopted by the United States Pharmacopoeia as the official designation. This name was coined by me thirty years ago at a time when I supposed that the form in which I had succeeded in isolating it represented the base as it actually exists in the capsules

Without going into the details of earlier attempts to isolate the principle, all of which I have described in a historical paper published in 1903 (*Amer Jour. Pharm* 1903 *75*, p 301), I hope that you will permit me to say a few words about my own investigations towards *its isolation With the assistance of the late* A C Crawford I succeeded in separating the hormone from its numerous tissue concomitants in the form of a benzoyl derivative. On decomposing this benzoyl derivative with hot dilute sulphuric acid in an autoclave we obtained the active principle in the form of a sulphate which possessed the characteristic physiological activities of suprarenal extracts and reacted, furthermore, with a series of chemical reagents in a manner that is quite specific for such extracts and limited to them The principle as obtained by saponification of the benzoyl derivative was thrown out of its solution by means of ammonia in the amorphous state and was shown to be a weak base A picrate, a bisulphate and other salts of it were prepared, all of which were shown to possess a high degree of physiological activity An acetyl derivative, a phenylcarbamic ester and other derivatives were also prepared and certain degradation products of the base were isolated and studied Without giving any further details of this earlier work, which occupied my time for a number of years, I will merely state that the elementary composition of the base was established by analysis of several derivatives, including a sulphate, and was stated to be represented by the formula $C_{17}H_{15}NO_4$ (*Zeit f physiol Chem*, 1899, xxviii, 318)

After I had completed the above described investigations and while I was still endeavoring to improve my processes I was visited one day in the fall of 1900 (as I recall it) by the Japanese chemist, J Takamine, who examined with great interest the various compounds and salts of epinephrine that were placed before him He inquired particularly whether I did not think it possible that my salts of epinephrine could be prepared by a simpler process than mine, more especially without the troublesome and in this case wasteful process of benzoylating extracts of an animal tissue He remarked in this connection that he loved to plant a seed and see it grow in the technical field. I told Takamine that I was quite of his opinion that the process could no doubt be improved and simplified At this very time also, v. Fürth had just prepared an amorphous, highly active, indigo-colored compound of the active principle, which he named suprarenin, but no analytical data were given and no empirical formula for his principle was established

Takamine prepared suprarenal extracts more concentrated than mine, and without first attempting to separate the hormone from its numerous concomitants by benzoylating or otherwise, simply added ammonia —the reagent that I had so long employed—to his concentrated extracts, whereupon he immediately obtained the native base in the form of burr-like clusters *of minute prisms in place of my amorphous base* I have often been asked why I had not myself attempted to solve the problem in this very simple fashion. The truth is that I had tried to do so but always found that the dilute extracts tested simply turned pink in a short time on the addition of ammonia without depositing a base, either crystalline or amorphous Inasmuch as even very dilute solutions of the salts obtained by me on saponifying the benzoyl derivatives always gave a precipitate with ammonia, I fell back on the hypothesis that other constituents of the impure extracts prevented its precipitation by ammonia from my dilute native extracts—an erroneous assumption. Takamine's success was due to the employment of ammonia on very highly concentrated, though impure, extracts. The fact that my amorphous base could be precipitated from even highly dilute solutions was, as I soon found, due to the fact that one benzoyl radical had not been removed during the saponification Takamine adopted the empirical formula $C_{10}H_{15}NO_3$ as the "probable empirical formula" of his substance, which was immediately patented in this country and manufactured, greatly to the advantage of medicine I was soon able to demonstrate that my epinephrine—$C_{17}H_{15}NO_4$ —had retained a single benzoyl radical, C_6H_5CO, that had resisted saponification and could only be removed from the base by drastic treatment with strong acids and heat, a treatment which at the same time obliterated every trace of the characteristic physiological action of the hormone (Johns Hopkins Hospital Bulletin, 1901, vol xii, p 337) I suspect that the retained radical was attached to the imide nitrogen of the side chain of the molecule—an unusual circumstance in any event Subtracting the molecular weight of the retained radical from my original formula, $C_{17}H_{15}NO_4$, leaves $C_{10}H_{10}NO_3$, which formula is very close indeed to that assigned by Takamine to his crystalline base, and Aldrich, who had been my assistant and who, coincidently with Takamine and quite independently of him, also discovered that the base is obtainable in crystalline form when ammonia is added in sufficient quantity to a highly concentrated suprarenal extract, wrote, with-

out knowing at the time that I had already discovered the concealed radical. "It is interesting to note in this connection that if we subtract a benzoyl residue from Abel's formula for epinephrin—$C_{17}H_{15}NO_4$—we obtain a formula $C_{10}H_{10}NO_3$ which is not far removed from that of adrenalin." (*Amer Journ, Physiol*, vol V, p 461)

I venture to say in extenuation of the blunders of a pioneer in this field that the results obtained by me and my close approximation to the true elementary composition of the hormone were not due to chance, but could have been obtained only from the study and analysis of a series of fairly pure chemical individuals Every one of these derivatives had, however, as already stated, retained a single benzoyl radical The efforts of years on my part in this once mysterious field of suprarenal medullary bio-chemistry, marred by blunders as they were, eventuated, then, in the isolation of the hormone, not in the form of the free base but in that of its monobenzoyl derivative Aldrich finally established the true empirical formula, $C_9H_{13}NO_3$, the correctness of which was afterwards conclusively verified by others abroad.

I can not look back on my own poor efforts to elucidate the chemical constitution of the compound with pleasure After the preparatory pioneer work thus far outlined there followed the brilliant researches, in respect to the chemical constitution of the hormone, of the chemists, Dakin, Jowett, Pauly, Friedmann, Stolz and Flächer, which have finally culminated in the synthetic production, first of the racemic and later of the laevo-rotatory form, as produced in the animal organism itself The work of these chemists has shown that the suprarenal medullary hormone is an aromatic amino-alcohol, dihydroxy-methyl-amino-ethylol-benzene,

$$C_6H_3(OH)_2\ CHOH\ CH_2\ NH\ CH_3.$$

The cells of the medullary portion of the suprarenal gland are intimately related in their origin to the sympathetic nervous system, and we are not surprised therefore to find their secretory product, adrenalin or epinephrine (U S P), has a pharmacological and quite specific affinity for the sympathetic nervous system—the thoracic-abdominal part of the autonomic nervous apparatus. The changes induced by epinephrine in the activity of the various organs innervated by this system are in all respects like those that are brought about when the sympathetic fibers controlling these organs are stimulated by an electric current A small quantity of the hormone administered intravenously will cause vaso-constriction, increased rapidity of heart action, dilatation of the pupil, relaxation of constricted bronchioles, inhibition of the peristaltic movements in the alimentary canal, contraction of the pyloric and ileo-coecal sphincters, increased motility of the pregnant uterus and mobilization of the glycogen of the liver with a resultant glycosuria. We have here then an example of a definite chemical principle of known structure which, when carried by the blood to a terminal point of the sympathetic system, induces exactly those alterations that follow electrical stimulation of the sympathetic fibers that pass to these terminal points. In more technical pharmacological terms, the hormone stimulates, sensitizes or acts in an inhibitory manner on sympathetic myoneural or adenoneural, junctions of the sympathetic nervous system Because of this highly specific action this hormone and the many others of its class that have been isolated in recent years from various animal, plant and bacterial products have been given the name of sympathomimetic amines.

I can not pause to give an account of the various beneficial uses which several of these sympathomimetic amines have found in medical practice Nor can I enter upon a chemical or pharmacological analysis of these numerous, naturally occurring or synthetically prepared, biologically very important substances that are classified with epinephrine as phenylalkyl- or phenylalkanolamines This group is only one of many groups of physiologically more or less active substances grouped together as a class of biogenous amines

It is worth while pointing out in this connection that from the structural point of view a whole series of alkaloids, as hydrocotarnine, anhalamine, anhalonidine, papaverine, laudanine, bulbocapnine, corydine, berberine, canadine, cryptopine, protopine and many others can be brought into genetic relationship with the phenylalkylamines above referred to, as has been outlined by Elger.

I may conclude this section of my lecture by a brief description of a plant principle, ephedrine, closely related in structure and physiological action to the hormone of the suprarenal medulla For more than 5,000 years the Chinese have used the stems of *Ephedra vulgaris*, under the name of Ma huang, as a medicine famed among them as a diaphoretic, a circulatory stimulant, a sedative in cough and an antipyretic. The Japanese chemists Yamanashi and Nagai first isolated from Ma huang a derivative of phenylethylamine and named it ephedrine The chemical structure of this laevo-gyrous plant base has been determined and is evident from its formula,

$$\begin{array}{l} C_6H_5\ CH\ OH\ \underset{\displaystyle|}{CH}\ CH_3 \\ NH\ CH_3 \end{array}$$

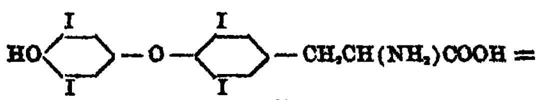
1-phenyl-1-hydroxy-2-methylaminopropane It will

be noted, on comparing this structural formula with that of epinephrine, that ephedrine contains two asymmetric carbon atoms as compared with the one of epinephrine, which latter also differs in containing two phenolic hydroxyl groups in the ortho-position to each other, making it much more susceptible to oxidation than ephedrine Ladenburg and Oelschlagel, who determined the chemical structure of ephedrine, have succeeded in isolating from the *Ephedra vulgaris* of Europe a stereoisomer, pseudo-ephedrine, which is not, strictly speaking, an optical antimere in its configuration Its dextro-rotation is due to a difference in the spatial arrangement of the alcoholic hydroxyl group of the above structural formula. The four possible isomers of ephedrine have been prepared synthetically and isolated and an extensive literature has already appeared in connection with their chemical and pharmacological properties and with the medical uses of the laevo-gyrous isomer, ephedrine. The pharmacological action of this plant phenylalkanolamine is qualitatively identical with that of the suprarenal base, epinephrine, in other words, it is a typically acting sympathomimetic amine It is less active physiologically than the latter, but its effects are more prolonged In the form of ephedrine sulphate it has already been found to be of great value in nasal operations and in ophthalmology Its ultimate value in serious diseases of the heart, in shock, hypotension and other pathological states is now being made the subject of numerous investigations

The Hormone of the Thyroid Gland

A second hormone, the chemical constitution of which has only recently been unravelled, is that produced by the thyroid gland, a small trilobed organ set astride the windpipe, below the larynx, and weighing in man 35 grams or 1¼ ounces. In this connection I may add that we are also endowed with a number of very small endocrine organs, the parathyroids, usually four in number, two on each side of the neck, closely adherent to the dorsal surface of each lateral lobe of the thyroid gland. While the thyroid gland of man weighs about 35 grams or 1¼ ounces, the four parathyroids, each about the size of a hempseed, weigh together only half a gram or 7 to 8 grains These minute glands, like the thyroid itself and most of the other organs of internal secretion, have an unusually good blood supply and are essential to life, one of their known functions being that of controlling in some as yet undefined manner the chemical combinations of the calcium in the tissues. Their hormone has not yet been isolated.

The hormone of the thyroid gland was first isolated in crystalline form by E C. Kendall in 1914, and was named thyroxine by him. A year ago C H. Harington, of University College Hospital, London, described an improved method for the separation of thyroxine from the thyroid tissue and by the brilliant application of well-known methods of break-down and synthesis obtained an iodine-free degradation product, desiodothyroxine, differing only from the natural hormone in being devoid of the four iodine atoms present in the latter Harington next succeeded in working out the constitution of this desiodothyroxine and found it to be the p-hydroxyphenyl ether of tyrosine. Next, Professor Barger and he conjointly prepared in a masterly manner a series of organic derivatives which were utilized in finally effecting the synthesis of the hormone in its racemic form The brilliant work of these investigators, carried out along classical chemical lines, has now incontestably established the constitution of the hormone as being β-[3, 5-diiodo-4-(3′, 5′-4′-hydroxyphenoxy) phenyl]-α-aminopropionic acid, as represented by the following formula



$C_{15}H_{11}O_4NI_4$

Synthetic thyroxine, as prepared by Harington and Barger, is obtained in the form of a crystalline precipitate consisting of rosettes and sheaves of colorless needles The compound is insoluble in water and the usual organic solvents, soluble at room temperature in solutions of the alkali hydroxides, provided their concentration be not too high It dissolves in sodium carbonate solution only on boiling and is soluble in 90 per cent alcohol containing either an alkali hydroxide or a mineral acid Sodium, ammonium and barium salts have been prepared which agree in their properties with the corresponding salts of the natural product The identity of the synthetic product with the natural hormone has thus been conclusively established by the brilliant researches of Harington and Barger

Professor D Murray Lyon, of Edinburgh, has studied the effects of synthetic thyroxine on two myxoedematous patients whose basal metabolism rates were respectively 32 and 45 per cent. below normal. After intravenous administration to each of the two of a total dose of 14 mgs. of the hormone, given in divided doses over a period of six days, the basal metabolism of the one rose to within 6 per cent. of normal and that of the other to 3 per cent. above normal It is concluded, therefore, that the effect of synthetic thyroxine in raising the basal metabolic rate of these two patients is quantitatively similar to that reported by Boothby and Sandiford, of the Mayo Clinic, in 1924, for natural thyroxine.

THE PANCREAS AND ITS HORMONE, INSULIN

Of the endocrine glands which are now being so actively investigated, I have selected for further discussion the pancreas and its internal secretory product, insulin Needless to say that within the brief time left I can do no more than just touch on a few of the important researches that constitute the historical background for our present conception of the indispensable rôle of this gland in carbohydrate metabolism There are four important milestones in the history of carbohydrate metabolism which can receive but the barest mention here

1 The epoch-making researches of Claude Bernard in relation to the functions of the liver and pancreas and more especially with reference to their rôle in carbohydrate metabolism constitute the first of the four milestones Bernard, in his masterful and logical way, worked out the fact that the liver is capable of polymerizing dextrose into a starch—or dextrin-like substance which he named glycogen because the hepatic tissue is able, through the agency of a ferment, to reconvert it into sugar His findings caused Bernard to view the liver as an organ of internal secretion (and he was one of the first to use this term), that is, an organ which manufactures in its cells a product which can be converted into a substance transportable by the blood to all parts of the body and utilizable by the tissues Bernard, not content merely with proving the existence of such a product in the liver, set out to extract and to isolate it from this organ in pure form, a feat which he accomplished in 1857 after many years of preliminary work Having now isolated glycogen, Bernard determined the conditions under which it is formed and is reconverted into sugar, and before long he was able to show that the reciprocal relationship between glycogen and glucose in the animal organism is entirely analogous to that existing between starch and sugar in the metabolism of plants The name animal starch, by which glycogen is frequently called, is therefore well taken

II The second important development in this field came when the pathologist Langerhans, then a young investigator in Virchow's laboratory in Berlin, discovered (1867–69) that there are contained in the pancreas groups of cells situated between the acini and markedly different from those of the ordinary glandular type. These groups, usually round, are composed of small, irregular, polygonal cells with a round nucleus and a homogeneous refractive cell body. Numerous observers have verified this discovery and they have been designated ever since as the islands of Langerhans or the islet tissue. These islands of Langerhans are the seat of formation of the pancreatic hormone, which has been appropriately named insulin in accordance with the suggestion first made by the Belgian, de Meyer, in 1909 and independently by the distinguished physiologist, Schäfer, in 1916 and adopted at the latter's suggestion by the Toronto workers But the proof that the islet tissue of the pancreas produces the hormone was not established until near the close of the last century, and it required the joint labors of many investigators to establish this point with certainty

In certain teleostean fishes, the islets, homologous in structure and in their function with those of Langerhans, exist as organs quite separate from the pancreas, and an additional link in the chain of evidence in support of the theory that the islet cells alone can produce insulin was furnished by the Toronto investigators, Macleod and his associates, who extracted the hormone from these specialized teleostean organs and found that it possessed the physiological properties of the insulin prepared from the pancreas of beeves. The islets are more abundant in the pancreas of the higher animals than was formerly believed to be the case In the entire pancreas of the guinea pig, according to Bensley, as many as 56,000 islets have been counted, "so that the endocrine tissue, instead of being rather scant, as it has usually been thought to be, is rather abundant" (Macleod)

III. A third great step forward was taken in 1889–91 In those years the clinicians v Mering and Minkowski discovered that complete removal of the pancreas from dogs is followed by a diseased state which is practically in all respects like that seen in human diabetes mellitus This clean-cut piece of experimental work, with the consequences that are logically deducible from it, constitutes one of the greatest achievements in this field since the discovery of glycogen and the demonstration of its physiological properties by Claude Bernard fifty years before. These consequences, indeed, played the chief rôle in the establishment of the proof outlined above under the heading (II) that the islets of Langerhans are the seat of formation of insulin, and furthermore, when taken in conjunction with the subsequent findings of pathologists, as Opie and others, they forced on men's minds the conviction that the cause of that frequently occurring and serious disease, diabetes mellitus, must be referred to an inadequate functioning of the islets.

The crucial demonstration by v Mering and Minkowski that ablation of the pancreas leads inevitably to diabetes naturally served as a great impetus to further research which confirmed their work and paved the way for the fourth great historical event in this field, presently to be described Leaving out here all reference to the investigations of about twenty workers in the decade or two following the discovery of v. Mering and Minkowski, let me speak very briefly

of the results obtained by workers in this field closer to our own time, results that almost succeeded in giving us insulin 15 years ago. The Toronto investigators have, in a very generous spirit, given full credit to the unsuccessful attempts of their predecessors to prepare serviceable extracts of the pancreas. In 1908 Zuelzer prepared an alcoholic extract from the pancreas of recently fed animals and obtained rather striking results from its use on a pancreatectomized dog and on eight diabetic patients. It is interesting to note, in studying Zuelzer's protocols, how greatly both the output of urinary sugar and of the acetone bodies was reduced in his patients as the result of the intravenous injection of his preparation. Untoward symptoms, such as a rise of temperature and chills, appeared both in Zuelzer's patients and in those of Forschbach, another clinician who tried Zuelzer's extract. In the opinion of the latter, the alleviation of the symptoms in diabetic patients was due rather to the febrile reaction induced by the injections than to a specific action of the hormone assumed by Zuelzer to be present in his extracts, and so it fell out that the successful use of pancreatic extracts for the treatment of diabetes has had to wait until our day for men equipped with newer methods and who, above all else, based their conclusions both on evidence obtained from well controlled animal experimentation and on clinical experience with diabetic patients.

E. L. Scott, who worked in this city in 1911–12 in Professor Carlson's laboratory, also came very close to obtaining a pancreatic extract that might have been serviceable, had it been tried out on human beings, since, by his method of preparation, blood-pressure lowering substances were removed. Scott's extracts, when injected intravenously into completely pancreatectomized dogs, diminished temporarily the sugar excretion and lowered the D : N ratio of the urine. Unfortunately, however, this investigator did not properly interpret his findings, inasmuch as he concluded that it does not follow that the effects induced by his extracts were due to the presence in them of the internal secretion of the pancreas. In 1913 Murlin and Kramer, in their study of the effects of pancreatic extracts on glycosuria, were led to the conclusion that neither their extracts nor the transfusion of normal blood "is as yet of any practical importance in restoring to the depancreatized dog the ability to burn sugar." Kleiner, using emulsions of the dog's pancreas infused slowly into a vein of a depancreatized dog, observed a temporary but marked decrease in the blood and urinary sugars and regarded his findings as furnishing evidence in support of the endocrine theory of experimental diabetes.

Other attempts to prepare an extract of the pancreas that would be serviceable in lowering the blood and urinary sugars and in ameliorating the symptoms of depancreatized animals and of human diabetics can not be detailed here.

IV. The numerous discoveries since Claude Bernard's day, grouped together under three periods as above, constituted the indispensable foundation for a fourth step—the preparation of an effective and stable extract that would unfailingly, or with rare exceptions, restore completely to health persons, old and young, sufferers from and often the early victims of that hitherto unconquerable malady, diabetes mellitus.

All the world knows of the brilliant achievements of Banting, Best, Macleod and Collip and their collaborators, acting on an original suggestion of Banting, that have led to the fourth great epoch in the combined fields of bio-chemical, physiological, pharmacological and clinical investigation. The results of these talented investigators have been and will continue to be of incalculable value to mankind, and have opened up many new possibilities for the study and better comprehension of the difficult field of carbohydrate metabolism.

This brings me now to a brief account of my own endeavors and those of my collaborators to isolate and separate the true insulin hormone from its numerous concomitants in the therapeutic preparations now employed, serviceable as they are, in the treatment of diabetics. It is a proper aim of the scientist, a mandate even, if I may say so, is laid upon him, wherever it is humanly possible, to isolate and to identify the elusive and indispensable hormones from their complicated mixtures (messes, the chemist would say) in which nature presents them. Once this aim has been realized and the hormone has been separated as a well defined chemical individual, the next steps, such as the study of the constitution of the hormone and its eventual synthesis, if ultimately possible, fall to the chemist. As in all previous instances, the isolation of a hormone as a chemical individual gives to the biochemist and physiologist a cleaner approach for the solution of their problems than when they are compelled to use mixtures of unknown composition.

These studies were made possible through a generous grant from the Carnegie Corporation of New York. The earlier ones are set forth in the following publications from my laboratory. Abel and Geiling, *Journ. Pharmacol. and Exper. Therap.*, 1925, xxv, 423; Abel, Geiling, Alles and Raymond, SCIENCE, 1925, xlvii, 169. They deal chiefly with establishing the fact that sulphur in a labile form is an integral

part of the insulin molecule and that the physiological activity goes hand in hand with the labile sulphur content of the molecule. I next succeeded in obtaining insulin in crystalline form and during the past year its preparation has been so simplified that, starting with commercial preparations such as the dry powder manufactured by the Connaught Laboratories of Toronto (13 units per milligram) or the concentrated liquid extracts furnished by Eli Lilly and Co and E. H Squibb and Sons (250–450 units per cc), the crystals can be obtained in any desired quantity within a very few days The salient features of the new method, the full details of which are given in *The Journal of Pharmacology and Experimental Therapeutics*, 1927, xxxi, 65, can be seen from the following brief description of a typical experiment in which, starting with 2.001 grams of a Toronto powder evaluated at 13 units per milligram, there was obtained a total of 0 5284 gram of crystalline insulin Various samples of these crystals have been submitted to the insulin committee at Toronto for standardization, but owing to the press of other work the committee has not as yet been able to make a report on them. Our own standardizations of a recrystallized preparation against the International Standard Powder gave us a conservative value of 40 international units per milligram.

To the powder, dissolved in 20 cc of 10 per cent. acetic acid, was added 80 cc of brucine acetate solution (1 gram of base in 18 cc of N/6 acetic acid) and then 40 cc. of 13 5 per cent aqueous pyridine, the resulting "pyridine precipitate" was centrifuged off and the clear fluid treated with 40 cc of 0 65 per cent. aqueous ammonia The "ammonia precipitate" so obtained was likewise centrifuged off and the fluid set aside to crystallize in an Erlenmeyer flask. Next morning the walls and bottom of the flask were found lined with crystals which, after washing and drying, weighed 0 2776 gram The "pyridine" and "ammonia" precipitates treated in the same way gave further crops of 0 1458 and 0 0614 gram, respectively, and a final crop of 0 0436 gram was obtained from the residue left by evaporating in a current of air at room temperature the mother liquors from the preceding fractions. The total yield of crystals was thus 0 5284 gram

Starting with liquid preparations, the procedure is the same except that the crude insulin is first precipitated with insulin as described in earlier papers.

Measurements with the Michaelis' nitrophenol indi-

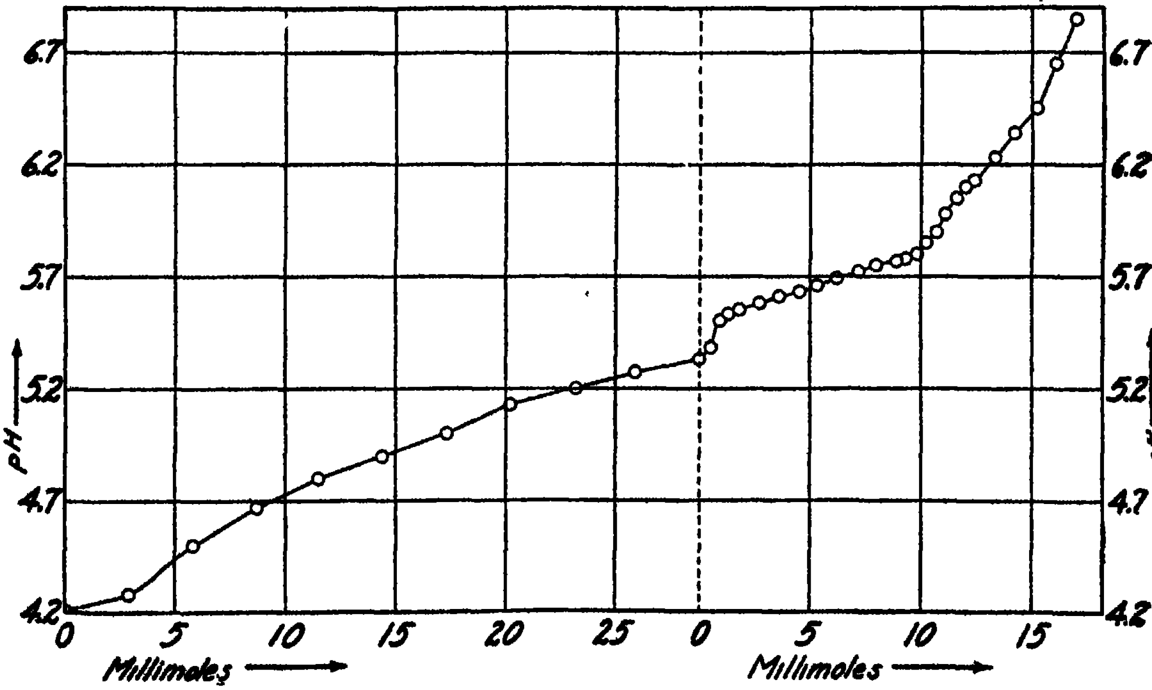


FIG. 1 TITRATION CURVE SHOWING pH VALUES OF A MIXTURE OF 40 CC. OF BRUCINE ACETATE SOLUTION (1 GRAM OF BRUCINE ALKALOID DISSOLVED IN EACH 18 CC OF 0 132 N ACETIC ACID) AND 10 CC OF 1 317 N ACETIC ACID UPON THE ADDITION OF PYRIDINE AND AMMONIA.

A total of 20 cc. of 1 441 N pyridine was added (left portion of curve), followed by 38 cc of 0 444 N ammonium hydroxide (right side of curve) The amounts of the bases added are plotted in millimoles The hydrogen ion concentrations were estimated colorimetrically with Michaelis' nitrophenol indicators, using 0.1 cc. of buffer mixture for each determination.

cators as well as with the quinhydrone electrode showed that the pH of the solution from which the insulin separated in crystalline form was 5.55–5.65. After centrifuging off the "ammonia precipitate" it may be necessary to add a little more ammonia to the fluid to bring it to the proper hydrogen-ion concentration before setting it aside to crystallize. The accompanying curve shows how the pH of a mixture of acetic acid and brucine, made up in the proportions employed in this method, varies with the gradual addition of the usual amounts of pyridine and ammonia.

The crystals are apparently dimorphous and fall into two general groups: (1) Crystals with well-defined double refraction, of negative character, with several habits, in the rhombohedral class, (2) crystals of a more equant habit, often with clearly defined crystal edges and no double refraction.

They give the Pauly, Millon, biuret and ninhydrin reactions but not the Voisonet, Hopkins-Cole or Acree tests for tryptophan or the Sullivan test for free cystine and cysteine.

The many solutions (in acetic acid, hydrochloric acid and ammonia) examined polarimetrically were always found to be laevo-rotatory, the magnitude of the rotation varying widely with the concentration and pH of the solution and with the nature of the solvent. For example, one preparation in hydrochloric acid showed a specific rotation of $-40°$, another, twice recrystallized, gave $-30°$ in N/6 acetic acid and $-17°$ in 0.011 N hydrochloric acid, with another in 0.65 per cent. ammonia the rotation was $-48°$ and changed in the course of several days through a maximum at $-63°$.

Numerous microanalyses on various preparations gave very concordant results agreeing closely with the empirical formula $C_{45}H_{69}O_{14}N_{11}S$ in the case of material dried at 105–20° in nitrogen under low pressure and $C_{45}H_{75}O_{17}N_{11}S$ (or $C_{45}H_{69}O_{14}N_{11}S \cdot 3H_2O$) for air-dried preparations; the labile or so-called "carbonate" sulphur content of the latter is about 1.10 per cent. or approximately 37.5 per cent. of the total sulphur. No satisfactory solvent for molecular weight determinations has yet been found.

No evidence has ever been obtained which would indicate that the crystals are not a homogeneous substance crystallizing in different types but a mixture of two substances, only one of which is physiologically active but both having the same solubilities and identical or nearly identical empirical compositions.

JOHN J. ABEL

THE JOHNS HOPKINS UNIVERSITY

SCIENTIFIC EVENTS

A STUDY OF ASCARIASIS

THE American Child Health Association has arranged to furnish support for an extended investigation of ascariasis, an infestation widely prevalent especially in children. Through the courtesy of the Johns Hopkins University, the work will be conducted under the direction of Professor W. W. Cort, of the department of helminthology of the School of Hygiene and Public Health, under the auspices of the division of medical sciences, National Research Council, through its Committee on Medical Problems of Animal Parasitology.

Professor Cort and his selected staff will investigate the life history of the parasite, its mode of transmission, the incidence of infestation, the effects upon infested animals and man and the methods of treatment and control. The central feature of the program will be the relation of this parasite to the health and development of children, since it is in young children that the infestation is the heaviest and the injury produced the greatest. Studies are to be undertaken in the School of Hygiene and Public Health, with the admirable facilities there available. Most of the investigations, however, will be in the field for which stations will be established at strategic points in the United States and their territories and insular possessions. The information and material yielded by the field work will be further studied, amplified and extended by, and correlated with, the investigations in Baltimore.

HOWARD T. KARSNER, *Chairman,*
Division of Medical Sciences,
National Research Council

GIFT OF WARD'S NATURAL SCIENCE ESTABLISHMENT TO THE UNIVERSITY OF ROCHESTER

THROUGH the gift of members of the Ward family, ownership of Ward's Natural Science Establishment, Rochester, N. Y., passes to the University of Rochester under conditions enabling its museum features to be preserved and its scientific work carried on.

Founded in 1862 by Professor Henry A. Ward, then holding the chair of geology in the University of Rochester, the establishment was carried on from the early eighties by the late Frank A. Ward, son of Levi A. Ward, who had largely financed the undertaking. Professor Henry A. Ward spent a large part of the year in travel in all parts of the world in search of specimens which were assembled and arranged at the workshops.

The following paragraphs are taken from a statement on the gift made by Raymond N. Ball, treasurer of the University of Rochester.

The University of Rochester feels greatly honored in being asked to accept the splendid foundation which the Ward family proposes to found in memory of Frank A. Ward.

It was the energies and business ability of Frank A.

Ward in financing and managing Ward's Natural Science Establishment from the early eighties until the time of his death that permitted Professor Henry A. Ward while alive to devote his full time and experience in the field, supplying the establishment with materials and thereby making such materials available for distribution to the scientific world. The university cherishes the memory of both of these eminent men who have contributed so much to the field of science. It accepts with a sense of keen responsibility the trusteeship of the Frank A. Ward Foundation, which is being founded so unselfishly by the living members of the Ward family.

In accepting this trust the university recognizes the obvious advantage which will accrue to its own scientific departments, both instructors and students, in continuing and controlling such a vast collection of scientific materials gathered from all parts of the world. It will also bring the university into intimate association with the leading scientific establishments both in this country and abroad. Furthermore, the university appreciates Mr. Hawley Ward's willingness to remain as director of the business interests of the institution.

Professor Henry A. Ward, the founder of the museum, was the second instructor in our geology department, succeeding Professor Chester Dewey in 1861 and serving in that capacity until 1875. The University of Rochester, chiefly because of Professor Ward, attracted considerable attention by its scientific offerings at that time, since it was the first college in America, if not in the world, to establish a course in science on an equality with the classical course. Furthermore, the university's museum collection of about 40,000 specimens purchased in 1862 was made by Professor Ward and was at that time the largest collection in geology, mineralogy, petrography and paleontology in America. In fact, few colleges at the present time are said to possess as good display and teaching collections. That this early tradition may be revived and our present facilities further strengthened by the permanent acquisition of the Ward's Establishment is naturally very gratifying.

The success of the greater university campaign in 1924 makes it possible for the university to accept this foundation in that the collection, now owned by the university, and such specimens from the present collection of the Ward's Natural Science Museum which are and can be used for teaching purposes will be most effectively used in the new museum which it is planned to build in connection with the biology and geology building on the new site for the college for men. This museum will be open to the public.

SCIENTIFIC LECTURES AT THE FRANKLIN INSTITUTE, THE CALIFORNIA ACADEMY OF SCIENCES AND THE UNIVERSITY OF CHICAGO

Following is the schedule to January, 1928, of lectures to be given at the Franklin Institute, Philadelphia:

October 19—*Engineering contributions of the gyroscope:* Elmer A. Sperry, Esq., president, Sperry Gyroscope Company, Brooklyn, New York.

October 27—*Animal mechanics:* Professor Ulric Dahlgren, department of biology, Princeton University.

November 10—*Modern research on the structures of metals.* Professor Wheeler P. Davey, department of chemistry, Pennsylvania State College.

November 16—*Automatic train control.* A. H. Rudd, Esq., chief signal engineer, The Pennsylvania Railroad.

December 1—*The design, construction and equipment of the Broad Street subway.* H. E. Ehlers, Esq., director, department of city transit, City of Philadelphia.

December 8—*Illumination in the industries.* Professor Dugald C. Jackson, department of electrical engineering, Massachusetts Institute of Technology.

December 21—*Talking and synchronized motion pictures:* William H. Bristol, Esq., president, The Bristol Company, Waterbury, Connecticut.

The California Academy of Sciences has announced lectures to be given in the auditorium of the academy's museum in Golden Gate Park, at three o'clock on Sunday afternoons as follows:

October 2—*Popularizing science through the public press.* Dr. William Emerson Ritter, president, Science Service, Washington, D. C. Illustrated.

October 9—*Golden Gate park as a botanical garden:* Miss Alice Eastwood, curator, department of botany, California Academy of Sciences, San Francisco. Illustrated.

October 16—*Home life of the Alaska willow ptarmigan:* Joseph Dixon, economic mammalogist, museum of vertebrate zoology, University of California, Berkeley. Illustrated.

October 23—*California's forest resources.* J. W. Nelson, assistant district forester, United States Forest Service, San Francisco. Illustrated.

October 30—*The work of "The Save the Redwoods League."* Joseph D. Grant, vice president board of trustees, California Academy of Sciences, San Francisco. Illustrated.

At the close of each lecture a moving picture film will be shown illustrating some phase of natural history.

On Friday evenings members of the scientific departments of the University of Chicago will give a series of lectures in the Lake View Building lecture room on the general subject, "The Nature of the World and Man," as follows:

October 14 and 21—*Astronomy.* William Duncan MacMillan, department of astronomy.

October 28 and November 4—*The origin and early stages of the earth.* Rollin T. Chamberlin, department of geology.

November 11 and 18—*Geological problems of the earth's history:* J. Harlen Bretz, department of geology.

December 2—*The message of a beam of light.* Harvey Brace Lemon, department of physics.

December 9—*The dance of molecules and flight of electrons:* Professor Lemon.

December 16 and 23—*The nature of chemical processes:* Julius Stieglitz, department of chemistry.

THE DEDICATION OF THE CHEMISTRY-PSYCHOLOGY BUILDING OF WITTENBERG COLLEGE

The dedication of the new chemistry-psychology building of Wittenberg College, Springfield, Ohio, will take place on October 21 The dedicatory address for chemistry will be given by Dr Edgar Fahs Smith, provost-emeritus of the University of Pennsylvania, and the dedicatory address for psychology by Dr J. McKeen Cattell Honorary degrees will be conferred, followed in the evening by a reception and a banquet, when Dr E E Slosson will be the speaker

In connection with the dedication a conference on chemistry will be held on October 20, 21 and 22 and a symposium on the "Psychology of Feelings and Emotions" has been arranged from October 19 to 22, by Dr Martin L Reymert, professor of psychology and director of the laboratory and editor of *The Scandinavian Scientific Review*

The preliminary program follows

CONFERENCE ON CHEMISTRY

Honorary Chairman—E E Slosson
Chairman—A F Linn.

Thursday, October 20

Forenoon session

Inspection of the Chemistry Building

W D Harkins, "Cosmic Chemistry"

Afternoon session

Wm E Henderson, "The Place of Chemistry in the Schools of the Orient"

E C Franklin, "The Ammonia System of Compounds"

Evening session

Colonel H L. Gilchrist, "Chemistry in War and its Medical Significance."

Friday, October 21

Forenoon session

H P Cady, "Physical Chemistry, the Doorkeeper."

Alexander Silverman, "The Future of Chemical Education"

Afternoon session

General academic program

Dedication of the Chemistry Building.

Edgar Fahs Smith, dedicatory address

Evening session

E E Slosson, "The Human Side of Chemistry"

Saturday, October 22

Forenoon session

H N Holmes, "The Place of Research in College"

Wm McPherson, "The Contributions of Ohio Chemists"

SYMPOSIUM ON FEELINGS AND EMOTIONS

Honorary Chairman—James McKeen Cattell
Chairman—Martin L Reymert

American Psychologists

(To be present in person)

James McKeen Cattell, "Early Psychological Laboratories" (General inaugural address.)

Herbert S Langfeld, Princeton, "The Rôle of Feelings and Emotions in Esthetics"

Walter B Cannon, Harvard, "Neural Organization for Emotional Expression"

W B. Pillsbury, Michigan, "Utility of Feelings and Emotions"

Joseph Jastrow, Wisconsin, "The Place of Emotion in Modern Psychology."

C E Seashore, Iowa, "A New Approach to the Psychophysics of Emotion"

Albert P Weiss, Ohio State, "Feelings and Emotions as Forms of Behavior"

D T Howard, Northwestern, "A Functional Theory of the Emotions"

William MacDougall, Duke, "The Distinction between Feelings and Emotions"

Knight Dunlap, Johns Hopkins, "Emotions as the Dynamic Background."

L. B Hoisington, Cornell, "Pleasantness and Unpleasantness as Modes of Bodily Experience"

Margaret Washburn, Vassar, "Emotion and Thought A Motor Theory of their Relation"

Madison Bentley, Illinois, "Is Emotion More than a Chapter Head?"

Harvey A Carr, Chicago, "The Differentia of an Emotion"

Morton Prince, Harvard, "Can Emotion be Regarded as Energy?"

Robert H Gault, Northwestern, "On Pleasurable Reaction to Tactual Stimuli"

H L Hollingworth, Columbia, "The Relative Contagion of Emotions."

G S Brett, Toronto, "Historical Development of the Theory of Emotions"

Among others who may participate are R. S. Woodworth and John Dewey, of Columbia, George M Stratton, California, John S Terry, of New York, representatives from American Public Health Association and American Child Health Association

European Psychologists

(Contributing by specially written papers to be read by proxy) Wednesday's sessions will be devoted to the reading of these papers.

William Stern, Hamburg, "The Ernst Spiel in Emotional Life"

Felix Krueger, Leipzig, "The Nature of Feeling A Systematic Theory"

David Katz, Rostock, "The Feelings of the Child as Expressed in its Conversation with Adults"

Werner Gruehn, Estonia, "Feelings and Emotions in the Psychology of Religion"

Pieron, Paris, "Emotions in Animal and Man"

P. Janet, Paris, "Fear of Action as the Essential Element in the Sentiment of Melancholia."

Carl Joergensen, Denmark, "Elements of Feeling."

F Kiesow, Turin, "The Feeling-tone of a Sensation."

C Spearman, London, "A New Method of Investigating the Springs of Action."

F. Aveling, London, "Emotion, Conation and Will."

Ed. Claparède, Geneva, "Feelings and Emotions."

Titles not yet received from the following Alfred Adler, Vienna, W Bechterew, Russia, Carl Buehler, visiting professor at Johns Hopkins, E Jaensch, Marburg, Germany

SCIENTIFIC NOTES AND NEWS

GENERAL HENRY L. ABBOT, the distinguished army engineer, died on October 2, aged ninety-five years General Abbot was elected a member of the National Academy of Sciences in 1872

THE Société Nationale d'Acclimatation de France has presented Dr Alexander Wetmore, assistant secretary of the Smithsonian Institution, the Isidore Geoffroy Saint-Hilaire medal in recognition of his researches and publications in ornithology

ON the occasion of the centenary celebration of the University of Toronto, twenty-six honorary degrees were conferred, including the degree of doctor of science on Dr Frederick James Alway, professor of soil chemistry, University of Minnesota, Sir John Bland-Sutton, past president of the Royal College of Surgeons of England, Dr Louise D Cummings, professor of mathematics, Vassar College, Dr Elizabeth Rebecca Laird, professor of physics, Mount Holyoke College; Dr William G MacCallum, professor of pathology and bacteriology, the Johns Hopkins University, Dr Thomas McCrae, professor of medicine, Jefferson Medical College, and Gaston Leon Ramon, director of the Pasteur Institute Annex The degree of doctor of engineering was conferred on David Law Hodges Forbes, general manager of the Teck Hughes Mining Company, Thomas Henry Hogg, hydraulic engineer for the Hydro-electric Power Commission of Ontario, and James L. Morris, civil engineer.

AT the founder's day exercises at Lehigh University on October 5, Dr Karl Taylor Compton, professor of physics at Princeton University, gave an address on "Specialization and Cooperation in Scientific Research" The university conferred on Dr Compton the degree of doctor of science and on Robert Culbertson Hays Heck, professor of mechanical engineering at Rutgers University, the degree of doctor of engineering

PROFESSOR MICHAEL I PUPIN, of Columbia University, will be the principal speaker at the conference of delegates in Easton on October 20, when Dr William Mather Lewis will be inaugurated as president of Lafayette College.

CLARENCE FELDMANN, professor of electrical engineering at the University of Delft, Holland, was elected president of the International Electrotechnical Commission at the recent meeting of that body in Bellagio, Italy Though a native of New York City, Professor Feldmann received his technical training at the University of Darmstadt, Germany, and has spent his entire career on the European continent

DR WILLIAM HENRY POTTER, professor of operative dentistry in the Harvard Dental School, has been made professor emeritus

DR. ISABEL S SMITH, professor of biology at Illinois College, Jacksonville, Ill, since 1905, resigned her position last June By vote of the college trustees, Miss Smith was made professor of biology emeritus Her permanent address will be Oberlin, Ohio Dr. Willis DeRyke has been appointed to the chair

DR. JOHN S Boyce, chief of the Portland, Oregon, office of forest pathology, Bureau of Plant Industry, has been made director of the Northeastern Forest Experiment Station, at Amherst The station has been in charge of S T Dana, who has resigned to become dean of the new school of forestry and conservation at the University of Michigan

DR. F E DENNY, of the Boyce Thompson Institute, has been called to Florida to investigate the possibility of raising crops of winter potatoes in the Everglade district west of Palm Beach The U S. Department of Agriculture is cooperating with the Florida Experiment Station in this investigation

NEW appointments were made by the Medical Fellowship Board of the National Research Council on September 24, as follows Dr William C Austin, in physiological and organic chemistry, Dr Arthur R Colwell, in chemistry and physics, leading to internal medicine, Wilton R Earle, in anatomy; Dr Edgar F. Fincher, Jr, in neurosurgery; Dr Louis H Jorstad, in pathology, Ethel D Simpson, in physiology, Dr Richard W Whitehead, in pharmacology, Dr. Harold G. Wolff, in neurology Dr Oran I Cutler, in pathology, was reappointed

DR ALEŠ HRDLIČKA, of the U S National Museum, sailed on October 1 for Europe, where he will examine the newest finds of early man in several countries and visit the type sites of Neanderthal man On November 8 he will read his address, following the award of the Huxley medal to him for important contributions to American anthropological science

DR ELLWOOD HENDRICK, curator of the Chandler chemical museum, Columbia University, who has been touring South Africa since June, expects to return to the United States at an early date

DR EDWARD J. MENGE, head of the department of biology and zoology at Marquette University, during

the past two months has been giving lectures before a number of South American universities, including the University of Cordoba in the Argentine, the University of Montevideo in Uruguay, the University of Chile in Santiago de Chile and the National Society of Medicine and Surgery in Rio de Janeiro, Brazil. Dr Menge was inducted as a member of the National Society of Medicine and Surgery of South America, and was made an honorary professor of the University of Montevideo

THE motor truck expedition to the Canadian Rockies, under the direction of Dr Charles E Resser and R S. Bassler, has returned to Washington with data which will permit the editing for publication of the last work done by Dr Charles D Walcott, late secretary of the Smithsonian Institution, on the stratigraphy of the Rockies Its purpose was to study and correlate the strata from one mountain range to another. The area worked by Dr Walcott is bounded roughly by the Columbia Valley, Bow Valley and Kicking Horse Valley With the information obtained this summer, Dr Resser expects to complete for early publication Dr Walcott's general account of all his work in the Canadian Rockies

GEORGE PALMER PUTNAM, explorer and publisher, returned to New York on October 6 after a four months' exploration in Baffin Land

DR. PAUL BARTSCH, professor of zoology at George Washington University, has returned to Washington after spending two weeks at the Tortugas studying the progress made in the hereditary problems which he is conducting upon mollusks.

PROFESSOR JOHN W HARSHBERGER has returned from a collecting expedition in South America with five hundred dried specimens of South American plant life, which have been added to the University of Pennsylvania botanical collection Duplicates have been sent to the New York Botanical Garden and the United States National Museum

DR. ALEXIS CARREL, of the Rockefeller Institute for Medical Research, returned from his annual summer vacation in France on September 21

SENATOR GUGLIELMO MARCONI, of Italy, has arrived in New York and will remain in the United States for two weeks to study the recent developments in radio made by American engineers

PROFESSOR L K RAMZIN, director of the Thermotechnical Institute of Moscow, has arrived in the United States to make a study of American electric power stations

DR. JOSEPH JASTROW, of the University of Wisconsin, will give a lecture at Columbia University on November 14. Another psychological lecture will be given on November 21, when Dr. Stanton Coit, of England, will discuss the mentality of apes. Later Professor H. A Overstreet, of the department of psychology in the College of the City of New York, will gives a series of four lectures on psychology

A MEMORIAL to Louis Agassiz Fuertes, lecturer in ornithology at Cornell University until his recent death, is being planned The memorial will be a bird sanctuary at the head of the lake at Stewart Park, Ithaca Plans for the development include transformation of the old Cascadilla boathouse into a museum or nature study center

DR. SAMUEL GARMAN, of the museum of comparative zoology, Harvard University, known for his work in ichthyology and herpetology, died on September 30, aged eighty-four years.

DR MARTIN S BRENNAN, professor of astronomy and geology at the Kendrick Theological Seminary, St Louis, died on October 3, at the age of eighty-two years

DR. WARREN GARDNER BULLARD, professor of mathematics at Syracuse University, died on February 16, at the age of sixty years.

PROFESSOR GUGLIELMO MENGARINI, one of the founders of the Italian Electrotechnical Association, died recently in Rome.

THE meetings of the International Union of Scientific Radiotelegraphy (U R. S. I.) opened in Washington on October 10. The discussion covered the work of the various branches of the Union since its last meeting in Brussels in 1922, and plans for future activities Delegates from nine countries were to attend. A session with scientific papers, which was open to the public was held on October 13 at the building of the National Academy of Sciences.

THE administrative board of the American Engineering Council has been called to meet at York, Pa., on October 20. Sessions will last two days. The president of the council, Dean Dexter S. Kimball, of Cornell University, will preside.

WITH 400 delegates in attendance, representing 70 nations and 41 communication companies, the International Radiotelegraphic Conference of 1927 held its opening session at Washington on Tuesday of this week in the presence of a distinguished gathering. The fundamental purposes of the conference, as described by Mr. Hoover, who is presiding, are "to arrive at such modifications as may be necessary in our existing international treaties to promote the wider use, reduce the conflicts and stimulate the

further progress of radio in international communications."

The twentieth annual Electrical and Industrial Exposition opened on October 12 at the Grand Central Palace, New York City.

The semi-annual meeting of the Upper State Psychologists will be held at Colgate University on October 21 and 22 The second morning there will be a trip and special clinic at the Utica State Hospital for the Insane Walter S Hunter, professor of genetic psychology at Clark University, will be the main speaker

The New England conference of the American Association of Museums opened at the New Eastland Hotel, Portland, Maine, on October 6

The first meeting of the Johns Hopkins Medical Society for the academic year 1927–28 was held on October 10 in the auditorium of the school of hygiene The meeting was dedicated to the memory of Lord Lister There were to be several short talks on various phases of Lister's life and work, leading up to the principal address of the evening by Dr. John Stewart, professor of surgery, Dalhousie University Medical School, Halifax, Nova Scotia. Professor Stewart was senior house officer under Lister in London Dr W G MacCallum, who represented the National Academy at the Lister Centenary Celebration, described that celebration in one of the briefer talks Dr E K Marshall, Jr., spoke on Lister's contributions to physiology and Dr W W Ford addressed the meeting on Lister's contributions to bacteriology

An International Physical Congress was recently held at Como, Italy Among well-known scientific men who took part were Rutherford and Aston, of England, von Laue, Franck, Gerlach, Stern, Sommerfeld and Born, of Germany; Cabrera, of Spain, Bohr, of Denmark, Debye and Schrodinger, of Switzerland, Cotton, of France; Corbino, Majorana and Volterra, of Italy; McLennan, of Canada, and Langmuir, Millikan and Wood, of the United States Topics dealt with included radioactive atoms and rays, molecular dissociation, magnetic susceptibility of alkaline vapors, magnetic properties of palladium and platinum, sound-waves of 300,000 cycles a second and cosmic rays.

The Eighth International Horticultural Congress opened its first session on September 20 in Vienna, under the presidency of the Chancellor, Dr. Sepel The meeting marked the one hundredth anniversary of the Austrian Horticultural Society. Sixteen countries were represented by 400 delegates, according to the London *Times*. Among the questions to be discussed at the congress were the conclusion of an international agreement on a uniform horticultural nomenclature and exact regulation of the naming of novelties (not newly discovered botanical species), with the introduction of national registers for such novelties, an international agreement on a uniform system of colors, and the necessity of affording legal protection for creators of floral varieties who, it is proposed, should be named for at least a period of three years whenever, in trade catalogues, mention is made of the novelty for which they are responsible

The first imperial agricultural research conference opened in London on October 1, with 170 representatives from all the Dominions of Great Britain, India and most of the colonies and dependencies The conference is the outcome of last year's imperial conference and is primarily a business establishment and clearing house of information for coordination of the work of local research institutes

An International Congress of Hygiene will be held in Paris under the presidency of Professor Léon Bernard, from October 25 to 28. According to the *British Medical Journal* the following questions will be discussed Relation of insurance to public health, introduced by Kuhn, of Copenhagen, Holtzmann, of Strasbourg, and Brian, of Paris, factors in the recrudescence of smallpox and the means of combating them, introduced by Ricardo Jorge, of Lisbon, Jitta, of the Hague, and Camus, of Paris, hygiene of education camps, introduced by Sacquépée, of Paris. Addresses will also be delivered by Professors Madsen and Ottolenghi

The Rockefeller school of biochemistry in the University of Oxford will be opened by the Right Hon. Viscount Cave, Lord Chancellor of England and Chancellor of the University, on October 21

The United States Civil Service Commission announces competitive examinations for chemical engineer at a salary of $3,800, associate chemical engineer at a salary of $3,000, and assistant chemical engineer at a salary of $2,400, applications for which must be received not later than November 8. The duties of appointees will be in connection with original research and development, or design and construction that is being conducted by the different bureaus in chemical engineering.

The new sixteen-room psychological laboratory at Colgate University has been opened The laboratory is divided into two parts, the first being a main laboratory of ten rooms for general applied and industrial experiments, and a special sleep laboratory of six rooms located away from the noise of the campus.

The committee on scientific research of the American Medical Association has made a grant of two

hundred and fifty dollars to Dr Warren C. Hunter, of the department of pathology, University of Oregon, for further study of the problem of local cellular immunity in renal epithelium.

DEAN C F BAKER, of the College of Agriculture at Los Banos, Philippine Islands, who died about three months ago, has left to the National Museum his collection of insects and some manuscripts, as well as a card index of Indo-Malayan entomology up to date, including about 100,000 references The collection comprises more than 1,450 schmitt boxes of mounted specimens, as well as a large amount of unmounted material.

ON September 24 fire destroyed the old Oak Hill club house situated on the site of the new men's college of the University of Rochester. The building had been abandoned preparatory to demolition, but the basement was being used for the storage of geological exhibition cases and specimens from the old geological museum on Prince Street Three exhibition cases that had been placed on the first floor of the club house were burned Four more exhibition cases and two hundred boxes of geological specimens in the basement were not harmed by the fire The lowest layer of boxes were half submerged in water, however, and their contents were necessarily dried and repacked The water did not injure the specimens or obliterate the labels The cost of repacking the specimens and the loss of the three exhibition cases were covered by insurance The material menaced by the fire was no part of Ward's Natural Science Establishment, which institution has become incorporated into the University of Rochester

WE learn from the *Journal* of the American Medical Association that Dr. John Whitridge Williams, professor of obstetrics, the Johns Hopkins University School of Medicine, Baltimore, has announced that a birth control clinic, supported by prominent physicians and others, will be opened this fall or winter on Broadway near the Johns Hopkins Hospital It will differ from birth control clinics in most places in that propaganda will not be dispensed, and persons will not be accepted unless sent to the clinic by a physician It will be purely an association of medical men and will be operated by them Dr Bessie L Moses will be in charge Dr. Moses is a graduate of the Johns Hopkins and an extern at the Johns Hopkins Hospital and was formerly connected with the Woman's Hospital in Philadelphia. Among those interested besides Dr Williams are Dr William H Howell, director, the Johns Hopkins School of Hygiene and Public Health, Dr. Adolf Meyer, professor of psychiatry, and Dr. Raymond Pearl, director of the institute for biological research.

THE Soviet Academy of Sciences has reported that it has discovered the resting place of a large meteorite, estimated to weigh nearly half a million tons, which fell in a remote district of Yenesei Province, Siberia, in the summer of 1908 The site of the fall occupies over a mile in diameter in almost inaccessible terrain in a marshy forest. The meteorite fell in pieces, so that the ground is pitted with deep funnels from 50 to 100 feet in diameter. The forest for over fifteen miles around the place was completely leveled and the fallen tree trunks scorched The fall, nineteen years ago, was registered on the seismographs at Irkutsk, 900 miles away, and in the towns of Kirensk and Ilimsk, about 250 miles distant.

UNIVERSITY AND EDUCATIONAL NOTES

MISS GWENTHALYN JONES, of Chicago, has made a gift of $200,000 for the endowment of a professorship in mathematical physics at Princeton University The chair will be named after her uncle, Thomas D Jones, of the Princeton class of 1876

THE University of Chicago will receive $750,000 for the establishment of a free school of mechanic arts by the will of the late Edward T Jeffery, banker and railroad executive

VANDERBILT HALL, the new dormitory of the Harvard Medical School which has just been completed, will be dedicated on October 14, when George E. Vincent, president of the Rockefeller Foundation, will deliver the principal address

DR WM RANDOLPH TAYLOR has been promoted to a full professorship of botany at the University of Pennsylvania. He recently returned from a fourth trip devoted to a study of Alpine lakes in the high mountains of British Columbia, completing a group of observations on Alpine algae peculiar to such situations, which have not previously been studied in America

JOSEPH B REYNOLDS, associate professor of mathematics and astronomy at Lehigh University, has been promoted to be professor of mathematics and theoretical mechanics. Dr. Reynolds spent the academic year just past, on leave, studying at Princeton University.

IN the department of physics at New York University the following promotions and additions have been made: Dr. H. H Sheldon, from associate to professor of physics; Dr. W A. Schneider, from instructor to assistant professor; Roger Estey, from graduate assistant to instructor, Edward O. Salant will work as a National Research Fellow in the department of

physics, Washington Square College, Dr. Francis A. Jenkins, formerly of Harvard University, has become an assistant professor of physics at University College on the Heights.

NEW appointments at Cornell University include those of Robert E Loving, of the University of Richmond, acting professor of physics, W W Nicholas, formerly National Research Fellow, acting assistant professor in physics, and John R. Johnson, of the University of Illinois, assistant professor of organic chemistry

AT the medical school of Western Reserve University, Dr Howard H. Beard has been promoted to an assistant professorship of biochemistry and Edward Muntwyler has been appointed demonstrator of biochemistry

DR HARVEY A ZINSZER, acting professor of physics at Mississippi State College for Women, has been elected professor of physics and acting professor of mathematics at Hanover College, Hanover, Indiana

DR CHARLES SPARLING EVANS, Ph D, Princeton, has been appointed associate in geology at Bryn Mawr College

M. A STEWART, formerly instructor in biology at the University of Rochester, known to entomologists for his work on Siphonaptera, has been appointed instructor in biology at the Rice Institute

DR. HOBART A REIMANN, who recently finished his research work as a fellow in medicine of the National Research Council at the University of Prague, has been appointed assistant professor of medicine at Peking Union Medical College, Peking, China.

DISCUSSION AND CORRESPONDENCE

THE EFFECT OF X-RAY ON TRYOSINASE

THE organic pigment melanin is considered to be the result of the interaction of tyrosine and tyrosinase. When mushrooms or potatoes are ground up with water the water contains a considerable quantity of the enzyme This can be demonstrated by adding a few drops of the water extract to a dilute solution of tyrosine. This colorless mixture during the first few hours passes through various deepening shades of wine to become black after twenty-four hours When either potatoes or mushrooms are X-rayed before their extraction with water, this extract invariably shows a decided increase in its powers of melanin production. This increase is in direct proportion to the strength of the X-ray dose. As far as the work has been carried exposures of 30, 60, 90 and 120 minutes at 90 KV., 22 ma., 26 cm. target distance result in increasing depths of color when added to a tyrosine solution that form steps sufficiently sharp to be obvious even in a photograph. Exposures over 2 hours and up to 4 hours produced no further perceptible change. From the results obtained with mice it seems probable that a very severe exposure of this enzyme would cause either a decrease or even a complete inhibition of its activity

ROBERT T HANCE

ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH AND UNIVERSITY OF PITTSBURGH

DEFINING SOIL COLLOIDS

ONE of the most popular and widely studied and discussed problems at the present time in the domain of soils is soil colloids And yet there are probably no two people interested in the subject who agree completely as to a definition of soil colloids The concepts and definitions of soil colloids seem to vary enormously Some people call soil colloids only soil particles of the very smallest size which have an upper limit of not more than .000005 millimeter, while other people call colloids soil particles whose upper limit is 005 millimeter and even .008 millimeter. It behooves us, therefore, to have a correct and standard definition of soil colloids

Now the vital question is, what standard are we going to adopt upon which to base a standard and correct definition of soil colloids?

There are two apparent standards that present themselves—one is the size of the particles and the other the activity or energy manifestations of the particles.

In choosing one of these two standards, it is absolutely necessary to choose one that has or presents a natural transition or demarcation point which divides the soil material quite distinctly into colloidal and non-colloidal

The activity or energy manifestations of the soil particles seems to meet the essential requirement of possessing a natural transition point which will divide soil material into colloids and non-colloids For instance, such energy manifestation or phenomena as adsorption of water vapor, base exchange, heat of wetting, etc., are possessed only by the soil colloidal material and not at all or very little by the non-soil colloidal material

A thorough examination of all the energy phenomena manifested by the soil particles that of the heat of wetting in water appears to be the most logical to adopt as a standard criterion for defining colloids.

The liquid to use in the heat of wetting measurement and hence, in the definition of the soil colloids is water. By using water all objections that might

be raised as to the specificity of the heat of wetting between soil material and different liquids, are overcome, because water, besides being the most natural and universal reagent, it is the chief natural agent by which soil colloids have been formed. Water is mainly responsible for the formation and physical condition of the soil colloids

If the heat of wetting phenomena is accepted as a criterion for distinguishing colloids from non-colloids then soil colloids could be defined as any soil material dried at 110° C that will give heat of wetting in water irrespective of size of particles

It has been found experimentally that nearly all the soil material classified as clay, and some of the very finest silt, give heat of wetting. This would include soil particles as large as 008 mm and even larger in some soils. Above the very finest silt there is hardly any measurable heat of wetting All the organic matter that gives heat of wetting would also be classed as colloids

According to the above definition of soil colloids then, any soil particles which give heat of wetting, which may be 008 mm or larger in size would be classified as colloids Such a definition and classification would be strongly objected to by those who believe that only material of the finest size, such as 000005 mm, should be classed as colloids But what will these people say when they realize that particles of 008 mm, or larger and having the same composition as those of 000005 mm, also exhibit energy phenomena the same as those of the smaller size, only of a slightly lower degree? Are we not justified then in classifying the larger particles under the same category as the finest? The present classification of soil colloids, which is based upon an arbitrary size of particles, is illogical A true classification should have for its basis a natural transition point, such as is possessed in the heat of wetting phenomenon, which shows definitely that above a certain size of particles the phenomenon of heat of wetting is not at all manifested

If the phenomenon of heat of wetting is adopted as a criterion for defining soil colloids, then we not only have what appears to be a logical and correct definition, but also, by the aid of such a definition, we can determine the colloidal content of soils, in less than 15 minutes as compared to more than 10 days by other definitions This is accomplished by the rather remarkable relationship that has been discovered to exist between the percentage of colloids as determined by the heat of wetting method, and the percentage of material that stays in suspension in a liter of water at the end of fifteen minutes. The heat of wetting method used for determining the colloids is by means of the ratio:

$$\frac{\text{Heat of wetting of soils}}{\text{Heat of wetting of extracted colloids}} \times 100 = \text{per cent. colloids}$$

The extracted soil colloids are obtained by allowing the dispersed soil to stand 24 hours in a beaker 6 inches high and siphoning off the material that stayed in suspension This method of extracting colloids seems to give the best representative sample of colloids in any soil.

It is firmly believed that the definition of soil colloids as proposed here is a natural and logical definition. It is simple, definite and comprehensive It will have very few exceptions

GEORGE JOHN BOUYOUCOS
MICHIGAN AGRICULTURAL EXPERIMENT STATION,
EAST LANSING, MICHIGAN

SCIENTORS APPEAR IN THE SOUTHWEST

A NUMBER of years ago some prosperous real estate operators awakened to the fact that they were being hampered in their chosen field by a motley array of amateurs of a low order. Something needed to be done and that quickly if real estate were to continue as an active field in which men of culture and refinement could profitably perform Accordingly a few of the more erudite among them formulated an imposing set of platitudinous rules which would not interfere with "business as usual," but which would permit disbarment of unwelcome competitors These gentlemen also had the wisdom to coin a new word—"realtor"—with which to dignify their new profession. Both the code of ethics and the new name were approved enthusiastically and are still in use, to the great benefit of all members in good standing.

Having seen what wonders a code of ethics accomplished for the barratrous real estate agents of the southwest, the scientists in that region have taken heart, and with true western optimism have adopted unanimously a set of trade rules of their own that should go far toward making the profession respectable—at least in the eyes of the public.

Many of us here in the economical East had no idea that science was in such a bad way in the far West. Of course we had our suspicions, but that investigators were mulcting each other of ideas and jobs, when they were not doing dishonest work for miserably inadequate pay, had never occurred to us. But the rules speak for themselves and show only too clearly just how deplorable everything is. Those interested in scientific slumming will find the reforms duly and dully set forth in SCIENCE[1] all nicely numbered and ab'd for ready reference.

[1] "A Code of Ethics for Scientific Men." SCIENCE, Vol. LXVI, No. 1700, pp. 103–104, July 29, 1927.

When once these rules are put in force, we can rest assured that the southwestern scientist in good standing will be courageously doing fine work, regardless of all sorts of prejudices. He will not be maliciously criticizing his colleagues nor will he have stolen their mental offspring or their means of subsistence. In fact he will be wholly respectable, scientifically speaking His pay will be adequate and he will enjoy administrative authority of a sort. His publications will be prompt but not too prompt and the public will be in his confidence, for he will have learned that the public pays the bills. He will be conversant with politics, religion and economics, but it will be useless to approach him on literature, history or philosophy, for these have been left to the charlatans as unworthy of ethical scientists.

With all this careful charting of the course of the true scientist the rules committee unfortunately neglected the all-important matter of a distinctive name and appropriate insignia for these new paragons of scientific virtue

As any realtor could have told them, rules are all right as far as they go, but the important thing is for the paying public to be able to discriminate between those who have a framed copy of the rules and those who have not The southwestern scientists, having aped the realtors to the extent of adopting a code of ethics, should go the rest of the way and grasp the substance of reform by choosing a name

The writer, ever anxious to encourage and aid in the salvation of southwestern science suggests "Scientor"[2] as a designation for those very earnest-minded practitioners seeking a way out of the wilderness—or what have you?

J H KEMPTON

BUREAU OF PLANT INDUSTRY

[2] Lest I be accused of transgressing Rule 10 of the southwestern code I hasten to admit having read a series of letters, appearing in *Nature* a year or so ago, in which the question of a proper designation for men of science was discussed. Although I am not conscious that Scientor was among the suggested appellations, it may well have been, and ethically I can claim credit only for appreciating its appropriateness for the group of men in question.

A DAYLIGHT METEOR

I READ with great interest the note of William L. Bryant, entitled "A Daylight Meteor," which appeared in the issue of SCIENCE of July 22, 1927. Several years ago, about four o'clock in the afternoon of a beautiful October day, while walking in the open country just north of the city of Stamford, Conn., I chanced to see at an elevation of about 30° above the horizon a veritable "ball of fire" moving in a northerly direction with an exceedingly high velocity. The brilliance of the moving body, which I immediately assumed to be a daylight meteor, was fairly dazzling notwithstanding the fact that the sun was shining brightly in the western sky During the brief interval that the meteor was visible its trajectory appeared to be nearly horizontal Unlike the luminous body observed by Mr Bryant, the daylight meteor which I chanced to see did not leave a train of sparks in its wake Unfortunately, I was alone at the time when this phenomenon occurred and hence was unable to compare my observations with those of an independent observer.

FREDERICK H GETMAN

QUOTATIONS

SCIENCE FOR CITIZENSHIP

OF the importance of science in any modern system of education there can here be no question but there is danger of a certain confusion of thought The value of the practical application of science was fully brought out during the war, it has been apparent in many of the problems which have arisen since the war; while scientific men have repeatedly and justifiably urged upon the public and the government the fundamental importance of the promotion of scientific research for all departments of the administration and life of the community and the British Empire This insistence upon the value of science, aided by a confusion between instruction in science and a technical training, has obscured its true function as an element in the training of the average individual in preparation for his duties as a member of the community. Now that science enters so widely and so intimately into every department of life, especially in all questions relating to health and well-being, it is essential that both the individual who ultimately through the vote will control policy, as well as those by whom that policy will be framed and carried out, should have a general knowledge of the scope and aims of science, as well as of scientific method and the mode in which science envisages and attacks its problems. It is, however, beyond question that it should be a general knowledge on broad lines: a specialized training in some highly technical branch of science is neither needed, nor indeed is it desirable. The educationist need feel no alarm.

As a medium of culture, the history of scientific discovery opens up to the imagination vistas of man's endeavor which place it in the front rank of humanistic studies Through a general familiarity with the

methods of scientific observation and experiment in the various branches of research may be developed a critical attitude in judgment, a power of observation and a capacity for orderly arrangement, while a knowledge of the questions with which science as a whole is concerned in the past, present and the future, fosters the broad outlook which, in combination with these qualities, is essential in successful dealing with the problems of life We doubt, however, whether much of the science teaching in schools, either primary or secondary, could be regarded as science for citizenship instead of science for specialists, and we should welcome a movement which would broaden its scope and change its character —*Nature*

THE FALL LINE OF THE EASTERN UNITED STATES

THE fall line is one of the most significant physiographic features of the eastern United States, but its origin has long been a mooted question The fall line is not particularly striking in its physical expression but its east-facing slope gives rise to a remarkable series of falls, rapids or deflections in the streams which flow from the Appalachian province across the Coastal Plain to the Atlantic Ocean

The fall line, or fall zone as it may more appropriately be called, has been commonly recognized as extending for more than 800 miles, from central Georgia to somewhere in the neighborhood of New York harbor, and following the contact between the crystalline rocks of the Piedmont area and the soft sedimentary formations of the Coastal Plain. All the early geologists and physiographers assumed that the fall line was a natural outcome of streams crossing the line of contact between two areas, one of resistant rocks and the other of relatively non-resistant rocks. This apparently adequate explanation was long given credence and, indeed, to-day many still hold to it But it must be rejected in the light of the fact that the upper portions of the streams on the Piedmont are as well graded as the lower portions on the Coastal Plain For if the falls were due to difference in the rate of stream development on areas of unlike rock resistance, the upper courses of the rivers should manifestly be in physiographic youth while their lower courses should be physiographically more mature. This is, however, not the case

It was soon recognized that the fall line was not explicable solely on the basis of difference in resistance to stream downcutting in two petrographic provinces, so in 1888, W J. McGee set forth the hypothesis that the fall line was due to monoclinal flexing or faulting. This theory appears to have been accepted by N. H Darton, N M Fenneman, Cleveland Abbe, Jr., Isaiah Bowman and many others. Joseph Barrell, however, clearly showed that while faulting does occur near the fall line in one or two places, there is no evidence of displacement throughout most of its length, particularly in places where some of the most pronounced stream declivities occur

W. M Davis in his "Physical Geography" (published in 1898) sets forth a very ingenious hypothesis, which if true is entirely adequate to explain the fall line On page 127, of this book, Dr. Davis gives in essence the following explanation: Before the Piedmont and Coastal Plain were uplifted the rivers had cut valleys of gentle slope leading to what was then base-level—the shore-line along the outer (eastern) edge of the Piedmont. After emergence, the extended rivers rapidly entrenched their lower courses in the non-resistant sediments of the Coastal Plain, while downcutting proceeded very slowly in the hard rocks of the Piedmont These new valleys of the lower courses of the streams, worked headward until they encountered the resistant rocks beneath the Coastal Plain sediments near its inner margin, where downcutting was checked. Thus the middle portion of the stream, between the gentle upper reaches on the Piedmont and the gently sloping lower entrenched portion in the Coastal Plain, possesses a relatively steeper slope and hence is marked by falls and rapids.

Davis's explanation is thus based on the assumption that the surface of the Piedmont is continued beneath the sedimentary formations of the Coastal Plain, and this embodies the necessary implication that the gradients of the Piedmont portions of the streams are less than the slope of the upland peneplane surface.

In order to analyze the problem quantitatively, the writer constructed many projected surface profiles across the Piedmont and Coastal Plain at right angles to the fall line, plotting on the profiles the outcrops of the various geological formations together with the depths of well borings in the Coastal Plain to determine the slope of the crystalline basement. Several different vertical exaggerations of scale were used in order that the various elements of the relief might be studied to best advantages.

The profiles show especially well the peneplain nature of the Piedmont upland and the New England upland. These uplands should probably be considered as two sections of the same peneplain (probably Tertiary in age). The slope of this Piedmont-New England peneplain surface varies from 5 feet per mile in Georgia to 18 feet per mile in Maine. The slope of the crystalline basement below the Coastal Plain varies from 36 feet per mile to 85 feet per mile, showing clearly that the Piedmont-New England up-

land surface is not continued beneath the Cretaceous formation of the Coastal Plain The much greater slope of the crystalline basement below the Coastal Plain makes the marked angle formed by the intersection of these two surfaces recognizable even when a small vertical exaggeration is used.

When records of scattered well drillings along a line in the Coastal Plain are plotted, they seem to indicate that the crystalline basement closely approximates a plane surface Very probably the surface of the crystalline basement is a buried peneplane developed during pre-Cretacic (Jurassic?) times The slope of this buried and tilted Jurassic peneplane emerges from beneath the Coastal Plain sediments, and continues upward along the face of the fall line belt of the Piedmont, being revealed through the stripping away of the Coastal Plain sediments by erosion The width of this stripped zone is slight, varying from 2 to 4 miles along the Piedmont. In New England, however, the Coastal Plain is entirely removed (except that portion which is below sea-level), leaving a stripped zone varying from 5 to 15 miles in width. The exposed edge of this old Jurassic peneplain is continued across the bottom of the Gulf of Maine with a width of about 15 miles.

Several writers have long known that the slope of the Piedmont is not continued beneath the Coastal Plain and that there are two upland slopes in New England, indeed, Davis himself has recognized this and commented on it But what is vastly more significant, it has not been recognized that since this is true no falls could result from the conditions embodied in Davis's theory If, as Davis suggested, the Piedmont rivers had established very gentle gradients leading to an ancient shore-line near the present "fall line," the upland profile and the stream profile must have been intersected at that point. After the emergence of the Coastal Plain, the extended rivers must have entrenched themselves in the soft Coastal Plain sediments until they had established nearly level channels in their lower courses, whereas downcutting proceeded very slowly in the crystalline rocks of the Piedmont This would have resulted in a broken stream profile in which the stream in the outer (eastern) Piedmont would have been entrenched but little below the upland surface, while in the western Piedmont and the Coastal Plain it would have been greatly entrenched.

But actual profiles show that the streams are entrenched as far below the upland surface in the eastern Piedmont as in the western Piedmont. If this fact is applied to a diagram showing the Piedmont surface as being continued beneath the Coastal Plain it gives only a simple concave stream profile which could yield no falls and rapids whatsoever. Thus the postulate of an ancient shore-line at the fall line is untenable, and the break in stream gradient is only incidentally related to differential entrenchment in areas of unequal rock resistance.

On the other hand, the profiles show that there is a marked break in the slope of the Piedmont-New England upland, and it is at this point that the streams which are *uniformly* entrenched below the upland surface exhibit the break in their gradients

The fall line zone, therefore, lies along the outer edge of the crystalline area (the Piedmont-New England Upland Province), where there is a break in the slope of the land due to the intersection of the recently exposed margin of the old, tilted Jurassic peneplain and the newer Tertiary peneplain of the uplands Since the gradients of the streams are closely related to the profile of the land, this break is sufficient to account for falls and rapids

George T Renner

University of Washington

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PRECIPITATION OF THE VIRUS OF TOBACCO MOSAIC

In an attempt to free the virus of tobacco mosaic from as much contaminating material as possible a method has been devised whereby the freshly cut diseased tobacco tissues are frozen, allowed to thaw, and then subjected to high pressure. The juice obtained, after being centrifuged, at about 2000 r p m., contains no large particles in suspension, but is highly infectious.

When two volumes of acetone (c p) at $-8°$ C. are added to one volume of the juice held at about 0° C a flocculent precipitate is thrown out and rapidly settles The supernatant liquid can be almost completely decanted within two minutes after adding the acetone, leaving the precipitate in the bottom of the container. More water may then be removed by rinsing the precipitate with acetone (c p) at $-8°$ C., decanting the acetone and then removing the remaining acetone with absolute ether at $-8°$ C. by rinsing twice and thoroughly draining off the ether The precipitate thus obtained is readily soluble in distilled water. Experiments in which young tobacco plants were inoculated with this solution showed it to be highly infectious. The first supernatant liquid decanted, on the other hand, when centrifuged to free it from all traces of the precipitate and diluted with two parts of distilled water proved to be non-infectious. The dilution was made in order to bring the

concentration of acetone below the point which Allard[1] showed was non-toxic to the virus.

Absolute alcohol may be used in place of acetone under the above-mentioned conditions.

At about 100 per cent. saturation and -8° C. ammonium sulfate salts out from the juice, material which, when filtered off and sucked dry, dissolves readily in distilled water. Plants when inoculated with this solution take the disease The filtrate when diluted, one to five, has in no case transmitted the disease, although the untreated juice when containing ammonium sulfate solution at a concentration of 3 cc of a saturated solution to 10 cc. of the juice is infectious.

Solutions of Safranin-O have also been used to precipitate the virus from the plant juice. This gives a quantitative precipitation, which frees the juice of virus.

CARL G. VINSON

BOYCE THOMPSON INSTITUTE FOR PLANT RESEARCH, YONKERS, NEW YORK

[1] Allard, H A. *Jour Agr Res.* 13. p. 619 (1918)

BROWNIAN MOVEMENTS WITH LOW MAGNIFICATION

THE desire having arisen for conspicuous Brownian movements, a variety of materials was pulverized with a view to ascertaining which showed the movements to best advantage For several reasons mica, particularly in the form of muscovite, was found preferable.

The suspension to be observed may be prepared as follows A quantity of mica from the edge of a natural slab is ground by a dry emery wheel into an impalpable dust. This is stirred into a graduate of water and allowed to stand for some four hours After the larger flakes have settled to the bottom, the thin milky suspension is siphoned off, care being taken not to draw off any of the useless residue at the same time The concentration of the liquid may, of course, be altered as seems convenient by evaporation or dilution

The liquid so prepared contains particles most of which are so small as to exhibit the Brownian movements Under a magnification of fifty diameters with oblique illumination from below the microscope stage, the flakes appear as bright scintillating points in a dark field This scintillation is evidently caused by small angular displacements due to the atomic bombardment, as the flakes rotate, they reflect the light at irregular intervals Mica is peculiarly well adapted to this method of observation because each thin particle has a moment of inertia small in comparison with its reflecting area.

In such a field, the movements are still conspicuous with a magnification of ten diameters, and have been suspected with the naked eye.

WILLOUGHBY MILLER CADY

BROWN UNIVERSITY

SPECIAL ARTICLES

HYSTERESIS LOSS IN NICKEL OF DIFFERENT GRAIN-SIZE

THE hysteresis loss in specimens of nickel crystals, which varied from one grain per specimen to as high as 2 8 × 10^6, has been examined by Sucksmith and Potter[1] and found to increase rapidly as the number of crystal grains increased Such an effect is not limited to specimens specially prepared as crystals but may be found as well in strips of ordinary nicke which have been successively cold rolled to thinner and thinner specimens and thus the number of crystals per unit volume increased step by step as well as the hardness

Of course all metals are crystalline, but in the case of the nickel strips which are cold rolled, it is not until severe cold working is performed that the crystals are more or less aligned[2] in one direction.

The present writer had occasion recently to study some of the magnetic properties of a series of eleven nickel strips reduced to various thicknesses by successive cold rolling. These strips were 57.7 cm long and about 0 954 cm. wide The thickest strip was .604 cm in thickness and the ten succeeding strips were rolled from this thickness to those given by the percentage cold reduction in the following table:

No. of Strip	Per cent. cold reduction from mill records	Hysteresis loss Ergs/cm³/cycle	Thickness	Chemical Analysis	
1	0 0	10861	0 604	Nickel	98.88
2	9.7	26146	0 550	Iron	0.56
3	18 9	29165	0 496	Manganese	0.23
4	28.6	30538	0.435	Copper	0.16
5	39.5	37526	0.372	Carbon	0.09
6	50.0	38732	0.306	Silicon	0.06
7	59.5	42373	0.249	Sulphur	0 008
8	69 0	43924	0.194		
9	79 0	51086	0.133		
10	89.1	55144	0.070		
11	93.3	55042	0.044		

[1] Sucksmith and Potter, *Nature*, 118, p. 730, Nov. 20, 1926.

[2] *Jeffries, Trans. Amer. Inst. Min. & Met. Eng.*, 70, p. 303, 1924.

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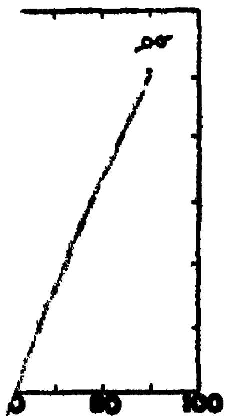

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stals of iron find a similar law holding
ork The same conclusion may be drawn
erlach's[5] curves for the magnetization of
igle iron crystals and electrolytic specimens
Sorensen[6] ascribed the high coercive force in thin films of iron, cobalt and nickel as due to the minute size of the crystals Edwards[7] had a similar experience The recent work of Ishagaki[8] on the effect of grain-size on the hardness of pure iron fits into the same picture.

It is interesting to note, on the other hand, that Welo and Baudisch[9] found for precipitated magnetite that "lean hysteresis loops, low coercitivities and low manences are associated with oxides composed of ll crystals."

S. R. Williams

...erweather Laboratory of Physics,
...herst College, Amherst, Mass

Williams, *Proc. A. S. S. T.*, 1926

[4] Honda and Kaya, *Sci. Reps.* Tohoku Imp. Univ, 15, p. 729, Nov, 1926.

[5] Gerlach, *Ztschr. f. Phys*, 38, p. 832, 1926.

[6] Sorensen, Amer. Phys. Soc Program, Abstract, Nov. 28–29, 1924, *Phys. Rev.*, 24, p. 658, 1924

[7] Edwards, Amer. Phys. Soc. Program Abstract, Dec. 28–30, 1925.

[8] Ishagaki, *Sci. Reps.*, Tohoku Imp. Univ., 16, p 285, 1927.

[9] Welo and Baudisch, Amer. Phys Program, Abstract, Feb. 26–27, 1926.

A DYSENTERY-LIKE BACILLUS FROM A PHLEGMONOUS INFLAMMATION

The bacilli belonging to the dysentery group have with few exceptions been isolated from the intestinal and urinary tracts. The writer has found but one reference to the isolation of one of this group from an extremity Magnusson, 1919,[1] isolated a dysentery bacillus, which he named *Bacterium viscosum equi*, from "joint ill" in foals. Since the bacillus to be described was isolated from a phlegmonous inflammation of the lower leg and foot of a man, it will, perhaps, be of interest.

The isolated bacillus has the following characteristics

Non-motile, Gram negative, non-spore-forming, short rods.
Aerobic and facultative anaerobic
Gelatin colonies grayish white, raised, entire
Gelatin stab no liquefaction
Agar colonies gray, smooth, entire
Agar slant gray, smooth, glistening
Broth turbid.
Milk. acid. Slow coagulation
Indol is formed.
Acetyl methyl carbinol not formed
Nitrates not reduced
H_2S not formed
Acid, but not gas, in lactose, saccharose, mannite, dextrose, maltose, raffinose, arabinose, adonite, sorbite, galactose, levulose, salicin, glycerin, xylose and trehalose
No acid or gas in dulcite, dextrin, inulin, inosite, amygdalin or rhamnose.

Andrewes, 1918,[2] proposed the name *Bacillus dispar* for all lactose-fermenting members of the dysentery group, but *Bacillus madampensis* Castellani, 1912, and *Bacillus ceylonensis* Castellani, 1909, were evidently included in the group as shown by the reaction of the strains of *B. dispar* to dulcite

The bacillus herein described differs from *B. madampensis* in that it ferments adonite and salicin, and does not ferment dextrin nor rhamnose The non-fermentation of dulcite differentiates the bacillus from *B. ceylonensis*.

Frederick W. Shaw

Medical College of Virginia,
Richmond

THE SELECTIVE EFFECT OF POLARIZED RADIATIONS ON CERTAIN PHOTO-CHEMICAL REACTIONS

The selective effects of polarized light as compared with ordinary light on biochemical reactions

[1] *Jour. Comp. Path and Therap.*, 32, 143.

[2] *Lancet*, 1918, 1, 560.

were first brought into prominence by Elizabeth Sidney Semmens (*Journ. Soc. Chem. Ind.*, 42, 954, 1923, also Brit. Assoc. Report, 1923).

In two previous notes by Bhatnagar and Lall and Bhatnagar, Lall and Mathur (*Nature;* February 27, 1926, and July 3, 1926) the effect of polarized light with the electric vector in the light-wave vibrating in the plane of incidence was shown to be selective on animal metabolism and on growth of *V cholerae* and *B. typhosis* Further work on the subject has been published from this laboratory in the *Indian Journal of Medical Research* (Vol XIV, No 2, October, 1926)

No positive results seem to have been so far recorded in favor of a selective effect on purely photochemical reaction, though there are some unsuccessful attempts described in literature (Ghosh, *Journ. Ind. Chem Soc*, 1925, Vol 2, p 269). Investigations were therefore undertaken to find whether polarized light would accelerate purely chemical reactions as it does some of the biochemical reactions studied by Baly and Semmens, Hill and Macht and Bhatnagar, Lall and Mathur Positive results have now been obtained in the case of the interactions of liquid amalgam of sodium or potassium and water This reaction was shown to be photo-sensitive by Bhatnagar, Mata Prasad and D. M Mukherjee (*Journ. Ind. Chem Soc*, 1925, Vol 1, 263)

The apparatus employed to obtain two fairly large patches of the polarized light and ordinary light of the same intensity was the same as described in a previous note (*Nature,* July 3, 1926) Spectra of the two beams of light taken in the visible region by means of an Adam Hilgers Spectrograph were found to be identical The heat-rays were cut off from the reaction vessels by interposing in each arm of the apparatus a rectangular glass cell containing a strong solution of alum The equality of intensities was measured by means of a Hilger Thermopile and Broca Galvanometer as described in the note referred to above. The polarized beam indicated a polarization of 90 5 per cent as measured by means of a Savart's polariscope

The reaction between the amalgams of the alkali-metals and water takes place in the dark, but is considerably accelerated by light even in the visible region. As a result of this reaction hydrogen and sodium hydroxide are produced

The rate of the reaction was studied in two ways (1) By measuring in a capillary tube the movements of a column of mercury due to the generation of hydrogen, (2) by titrating the alkali produced against a standard solution of an acid.

Both sets of experiments showed a remarkable

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standpoint, it appears so far that the ph
reaction in heterogeneous system only show
tive action and that the surface plays some
this reaction.

In this connection it is interesting to recall the remarkable discovery which Elster and Geitel made in 1894 that in certain cases the photoelectric effect is influenced by the orientation of the plane of polarization of the incident light Using also the liquid alloy of sodium and potassium and allowing polarized white light to fall upon surface, at an angle of 45°, they found a maximum current when the electric vector in the light wave was vibrating in the plane incidence and a minimum current when the elect vector was perpendicular to the plane of incidence These experiments have been confirmed by Kunz and a number of other workers and have received a satisfactory explanation through the work of Pohl and Pringshein (*Deutsch. Phys. Gesell,* Veb., 12, p 215–228, 349, 360, 1910).

It is proposed to apply and extend the view of Pohl and Pringsheim regarding this selective effect of polarized radiations to the case of photo-chemical reactions described in this note.

S. S. BHATNAGAR
UNIVERSITY CHEMICAL LABORATORIES,
UNIVERSITY OF THE PUNJAB,
LAHORE

SCIENCE

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CONTENTS

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THE GENE AND THE ONTOGENETIC PROCESS[1]

THE problem of the relations of genetics and physiology of development is essentially a modern problem much discussed of late, and recently expounded in very concrete form in Goldschmidt's "Physiologische Theorie der Vererbung." It was not visualized by Darwin and by Weismann, because, for each of them, the theory of development included the theory of heredity. However, their theories of determinants, both of development and of heredity, died on the field of battle in the "nineties" and the early years of this century. Mendelism arose, and the theory of heredity became by degrees the modern doctrine of the genes with its denial of *representative* particles and unit characters, but the determinant theory of development died childless, with no successor except a field of investigation which no single theory can compass.

Since Weismann, physiology of development and genetics have pursued separate and independent courses. Have these courses increased the divergence which became pronounced in the nineties of the last century when the untenability of a determinant theory of development was demonstrated experimentally to the point of silencing all former adherents? Or, on the other hand, has the immense progress made in both disciplines in the present century been of such a nature as to lead to an expectation of their ultimate reunion? There can be no doubt, I think, that the majority of geneticists, and many physiologists certainly, hope for and expect a reunion. The spectacle of the biological sciences divided permanently into two camps is evidently for them too serious a one to be regarded with satisfaction. The essays of Spemann, of Morgan, of Jennings and of Goldschmidt are symptomatic. The voice of Bateson on the other side, now unhappily silenced, is relatively lonely. I do not perhaps need to protest my love for both fields of work, nor my admiration of the investigations that have so widened our biological horizon in recent years. I would ask only to consider with you their mutual relations, whether to one another or with a *tertium quid* in the organism.

What are the reasons why geneticists and physiologists alike agree that there is present promise of a

[1] Evening lecture delivered at the Marine Biological Laboratory, Woods Hole, Mass., July 22, 1927.

reunion of genetics and physiology of development? The promise arose with the gradual abandonment of the essentially determinant point of view in genetics expressed in the theory of unit characters, and its replacement by the factorial hypothesis or gene theory, the most important general advance of genetic theory of our time. This advance at once broke down—or at least appeared to break down—an impassable barrier so long as the theory of genetics continued to be determinant in character, there could be no common meeting ground with physiology of development which had definitely passed that standpoint. The promise of reunion also rests, I think, on confusion of the physiological conception of heredity as repetition of life histories, and the essentially statistical examination of the reappearance of differentiating characters in successive generations which constitutes genetics. These are really very different things. There is also the justified feeling that such a pragmatically valuable conception as that of the genes must have profound physiological applications, but that again is a very different question—or perhaps only a small part of the question.

These mutually supporting ideas are undoubtedly very convincing; otherwise we should not have so outstanding a geneticist as Morgan maintaining that the application of genetics is one of the two most promising methods of attack on the problems of the physiology of development (1926), nor so outstanding a student of the physiology of development as Spemann pledging the aid of his science to genetics, nor should we find Goldschmidt devoting all his strength to the elaboration of a theory comprising development as well as genetics in its scope, and based throughout on the conception of the gene.

Let us then inquire into the prerequisites of an alliance between genetics and the physiology of development Since genetics has become quite a unitary science, and physiology of development is at most a field of work, we can best proceed by an examination of the necessary concepts of the latter followed by an inquiry into reciprocal relations for each concept

I. Concepts in the Physiology of Development

The necessary concepts that I propose to consider are those of the germ, of individuation, and of differentiation in its two aspects of embryonic segregation of potencies and of realization of potencies.

1. The concept of the germ is that of an organic entity of a relatively simple and undifferentiated character capable of producing a more or less specific organism of a relatively complex and differentiated order. The concept of the germ has thus of necessity somewhat of a teleological cast, which is seen in the implications of theories of development and heredity.

The germ exhibits the duality of nucleus and cytoplasm, the geneticist has taken the former for his field, the embryologist the latter, neither arbitrarily, but both of necessity, even while both admit that neither in genetics or in embryology does either operate alone The germ is the basis of all happenings in embryology and in genetics. A change in genetic germinal composition means changes in development all along the line No physiological event can be the same in two germs of different genetic composition, the divergence of characters that so emerges is then correctly referred to the initial germinal difference Let it be admitted once for all that genes are concerned in the genesis of all characters of the organism.

2. The germ is physiologically integrated as an individual at all stages. It may be first merely a cellular individual, then a definitely polarized individual with one or more axial gradients, as development proceeds, specific correlations, including those of definitely nervous and chemical natures, make their appearance. In short, the physiological principles upon which integration depends undergo differentiation, in the sense of progress from relatively simple and few to relatively complex and many, during development While individuality may thus *appear* to grow, it is in reality complete at all stages, only the means to its realization changing and multiplying with growing complexity.

3. Successive stages of development are marked by increasing complexity of organization, and each stage has its own characteristic features. The term "differentiation" is commonly used to cover this whole series of events We can, however, distinguish two logically very different series of phenomena overlapping in time to a great extent. The first, which is especially characteristic of early stages, is a process of origin of definitely determined loci (primordia), each with a specific potency. This process I propose to call in what follows *embryonic segregation,* on account of the resemblance of its sharply alternative character to Mendelian segregation, to which however it has no other observable resemblances. It is a process of origin of limited potencies. The second, which is especially characteristic of later stages of the life history, involves the realization of the potencies isolated in the final terms of the segregation process, thus involving histogenesis and definitive functional development.

Embryonic segregation may be characterized by the following features:

1. Its action proceeds from the more general to the more special in a definite sequence which is both dichotomous and discontinuous.

2. This results in a progressive genetic restriction, of a more or less fixed kind, in the primordia thus established.

3. These processes exhibit definite order, (a) in time, (b) in space, *i.e.*, localization in the whole, and (c) of determinate qualities coordinated both in space and in time.

4. There is a final term in each of the branches, which is followed by histogenesis and definitive functional differentiation, though certain terms (or branches) remain open throughout life. We may distinguish closed and open terms throughout life history with reference to embryonic segregation.

Comments are in order upon the above characterizations, for they concern I believe the most vital features of embryological development

The dichotomous and discontinuous character of the process is well illustrated by cell-lineage, and especially by Wilson's and Conklin's masterly analyses of this determinate form of cleavage Cell-lineage shows us daughter cells with such different prospective potencies as ectoderm and entoderm, or anterior and posterior quadrants of the embryo, and the experimental analysis shows us that these prospective potencies are also genetic restrictions The origin of these potencies in a single cell-division is dichotomous, and the discontinuity appears in their sharply differentiated genetic restrictions. This principle runs through all varieties of embryonic development, even if under different forms, as a great variety of experiments shows (*cf.* Spemann and Hoadley).

The space relationship in development, or the localization problem, exhibits itself with reference to the entire organism of which each primordium is a part, all primordia arise in definite areas, and their realization may involve a secondary more precise localization. For instance, the potency of the lens of the eye in amphibians lies in the embryonic epidermis at a definite stage of development, but the definitive localization within this area is not fixed until adjustment is established with the optic vesicle. The possibility of normal development depends among other things upon flexible, but finally precise, adjustments of localization of specific parts everywhere in the embryo. The situation implies correlations and inductions dependent upon extraorganic and intraorganic factors, and such relations have been demonstrated over and over again in experimental embryology. Child's gradient factors and principle of dominance are striking examples of analysis of factors of localization in the early embryo. The problems of localization, considered as such, would appear to be susceptible to physiological analysis.

Before examining the time process in development we must first consider the principle of embryonic induction of which we are hearing so much, and ask what it may be expected to explain and what it may not be expected to explain in the physiology of development. Environmental relations are very evident in many cases of embryonic localization, and it is natural to look for them in all cases The origin of the lens of the eye as an induction in the embryonic epidermis exerted by the optic vesicle is a well established example The experiments show that at this stage the epidermis of the head region, at least, possesses two potencies, however they may have arisen, and only two, *viz.*, to form lens cells, or epidermal cells which have lost the power of lens formation, which shall be realized in the case of any cell or group of cells depends on induction, in this case by the optic vesicle Note that this potency exists only for a relatively brief period of time, once accomplished, it can not be repeated In Driesch's terms the lens is positively restricted, the epidermis negatively restricted. Or take as another example the beautiful experiments of Spemann and his students. They show, for instance, that the ectoderm of the *gastrula* of Triton has two potencies and only two so long as it remains *in situ, viz.*, to form neural epithelium or general epidermis, each thereafter positively and negatively restricted. The experiments that show, that in this case the decision rests with the archenteron, is one of the biological triumphs of our time

Examples might be multiplied, but all would serve to show that induction produces only the phenotype[3] for which ontogenetic segregation has prepared the way, that the specificity of the response lies in the stage and locus, not in the inducing agent, and that the possibilities for any induction are only two in number.

This simple situation is often confused by two prevalent ideas—the one that potencies may be more

[3] W Johannsen, who introduced the word "phenotype," applies it not only to statistically determined modes in a population, but also uses it to designate in their entirety the personal qualities of any individual as given. (Elemente der exakten Erblichkeitslehre, dritte Aufl. 1926, pp. 162–163) It can hardly be regarded as an extension of Johannsen's definition to apply it to any stage of the organism as the purely descriptive condition of all its parts. The usefulness of this term in embryology is to abstract from a given stage all implication of future potency. "Phenotypical realization," therefore, explains itself as including the immediate circumstances that condition a given embryonic phenotype.

than two at one time and place; the other that the inducing agent may have determining value, *i.e.*, may be a so-called formative stimulus.

The first confusion arises from taking remote potencies into simultaneous consideration with immediate ones Thus the embryonic ectoderm of a mammal may be said to have the potencies of nervous system, lens, hairs, glands and epidermis. But these potencies do not exist simultaneously; when the ectoderm has the potency of forming nervous system, it does not have the potency of forming lens or any primordium of later origin. After the nervous system is segregated the ectoderm has lost the potency of repeating the process, and has acquired two new potencies and so on to the end of the chapter. Only two potencies at a time, and these realizable by induction. The same principle holds throughout the life history

Secondly, there is no such thing as a formative stimulus in embryonic development. Embryonic induction is no different in principle from induction of muscular contraction, or of nervous conduction or of glandular secretion. The nature of the response is conditioned by the immediate potencies of the responding system, and the nature of the stimulus is secondary. We are much more familiar with the inductions of differentiated tissues, and are unaccustomed relatively to the idea that the ectoderm of the gastrula for instance is giving its specific form of reaction when it forms a medullary plate; or the lens epidermis when it forms lens. Both because the idea is relatively unfamiliar, and also because the inducing agencies have been but little studied up to the present, we are apt to conclude that a new principle is involved, and that environment plays a different rôle in embryonic development from what it does in adult life But such a conclusion introduces endless confusion, and has not, in an experimental way, clarified any situation.

It is the non-repetitive character of the responses of embryonic segregation that really sets them apart from functional responses, such as the contraction of a muscle cell, for instance, which are repetitive. But this in itself does not assign a different rôle to environment in the two categories, as some have assumed.

There are theoretical viewpoints concerning development that neglect the processes of induction, and visualize only the more or less hypothetical processes of chemo-differentiation that run parallel with the ontogenetic current. Thus, visible substances in the unsegmented egg have been termed formative stuffs, on the assumption that they are the agencies of subsequent differentiations. When it was shown that visible substances of such kinds are not essentials of the specific local differentiations in which they normally occur, by the occurrence of properly localized differentiation, in spite of their displacement by centrifugal force, the theory reverted to invisible substances retaining their typical localization. Criticism must then revert to the *type* of explanation, against which it must be said that if there are as many kinds of purely hypothetical formative stuffs, as there are formations (*cf.* Goldschmidt), and so long as their physiological action is postulated only by their name, the view becomes indistinguishable from the determinant theory of Weismann. The theory does not become physiological by naming such hypothetical substances hormones (Goldschmidt), for these then become endowed with the same mysterious properties Again such an ultra-simplified conception as the "autocatalytic theory of development," also primarily "chemical"—if any one does indeed hold such a theory, as is rumored—does no more than visualize a single aspect of growth processes in the organism to the exclusion of the really essential aspects of development.

It is a mere truism that the energy of development is furnished by metabolism. I do not, however, regard the rôle of metabolism in development as essentially different at any stage from what it is in the adult. We know, in fact, relatively little concerning embryonic metabolism save its variations in rate in the time sequence of ontogeny measured by growth, or other criteria. We know also (or at least infer), by various rough indications, that metabolism varies qualitatively according to stage and locus. These differences, however, can not be regarded in general as determining factors of the course of development. They are primarily chemical indicators of differentiations already accomplished But, once accomplished, they become part of the intraorganic environment and function as such in development, whether as hormones or in numerous other ways.

So much concerning ontogenetic segregation The other aspect of differentiation realization of potencies—(histogenesis and functional differentiation)—follows the final stages or terms of segregation in the various branches of the ontogenetic tree when potencies are limited to a single one. Such terms of the ontogenetic process may, therefore, be called *closed terms* They may usually achieve their realization, to a considerable extent at least, in isolation from the remainder of the organism. Hence they are said to develop by self-differentiation. Such final terms are scattered all along the life history from a very early stage indeed. This situation, which is at least a very common one, differs from that in earlier stages of embryonic segregation, in which there are always two possibilities open to induction.

It is vastly important, however, that in the more

labile types of animals, at least, such as those of our own phylum, certain cells retain a double potency throughout life. These are the freedom-giving *open terms* of the ontogenetic process. A very beautiful example of this is found in the feather germs of sexually dimorphic birds, which according to alternative hormone conditions may blossom out as male or female feathers throughout life. The nervous system is also such an open system *par excellence*.

Let us return to the time aspect of development which concerns the sequential order of embryonic segregation It is measured not by time units, but by events. At each stage of the ontogenetic process specific forms of reaction, whether of the whole or of its segregated parts, occur. The order is quite invariable, at least within any given system, and, so far, this order has not been experimentally inverted in any of its parts.

On the physiological side there is no adequate theory of the sequential order of ontogenetic segregation. At the most we can speak only vaguely, and merely by analogy, of chain-reactions in a complex system, or if we take biological categories, and phrase the problem in terms of senescence for instance, whether we adopt a nucleo-cytoplasmic relation theory, or a theory of accumulation of inactive products (or whatever else may be possible) there is nothing to correspond in specific character, or in manifoldness, even in general principle, to the definitely ordered sequence of developmental events.

Granted that we may resolve development into a series of inductions that come to be better and better known, more and more fully analyzed, and a series of internally determined events or processes with only one typical outcome, is it not still entirely unknown why these inductions and events should be so typically various and discontinuous at different times in the life history? Granted that we may learn indefinitely more about specific constructive metabolism, and about growth processes of the entire organism or of its parts, do not the same considerations apply to these processes so far as they are various at different stages? All current theories in the physiology of development presuppose in fact a basic process of embryonic segregation in due sequence in time.

This scanty survey of a few triumphs of physiology of development, with its large lump of pessimism at the end, illustrates the impossibility of a single theory of development. Ontogeny is a moving equilibrium, which involves all fundamental physiological process at each stage, and it can no more be envisaged under a single formula than can the conception of life itself. Genetics on the other hand is subsumed under a single formula.

II. Relation of Genetics to the Physiology of Development

Now in which of these general situations of embryonic development does the theory of genetics play a rôle? or offer substantial assistance? As a matter of fact does any experimental embryologist use the conceptions of genetics in his work? If not, is it because the principles of genetics serve some entirely different situation? Let us proceed systematically.

Does genetics help in the conception of the germ? I think we may say that it certainly does, if the germ indeed contains "hundreds of thousands" of "different kinds of packets of chemicals" "massed in a haphazard way but arranged in a definite manner" Certainly no embryologist would have discovered that by his own unaided efforts. Admitting for the sake of the argument the essential validity of this addition to our actual cytological knowledge, does it aid in the experimental attack (as working hypothesis or otherwise) on the problems of the physiology of development? To answer this question we must examine each of the other concepts of the physiology of development.

Does it aid in the concept of individuation? I shall answer this question briefly because I think we shall all agree that it does not; that on the contrary it tends to confuse it. What principle is adequate to hold such a swarm within the bounds of individual being, or to direct their work! Individuation is clearly an environmental relationship, mediated through the cytoplasm, not through the nucleus.

With reference to the processes of embryonic segregation, genetics is to a certain extent the victim of its own rigor It is apparently not only sound, but apparently almost universally accepted genetic doctrine to-day that each cell receives the entire complex of genes It would, therefore, appear to be self-contradictory to attempt to explain embryonic segregation by behavior of the genes which are *ex hyp.* the same in every cell.

Goldschmidt has, however, attempted to do this. He has in fact postulated two mechanisms, which seem to be independent of one another in a logical sense, and which he has not clearly interrelated. The first is a theory of quantitative regulation of the genes, according to which each gene of the thousands concerned enters into activity at a rate, and therefore at a time, proportional to a precisely regulated initial quantity. This of course presupposes an underlying mechanism adequate to almost ultraphysically precise regulation in the germ, for which no model can be suggested; at the most it shifts the difficulty one step farther back. The second is the lock-and-key theory of substratum (cytoplasm) and gene, *viz.*, that each gene

reacts only with a specific substratum, from which it follows as corollary that specific substrata are always present at the appropriate time and place. This seems to me to postulate the process which it is invoked to explain, *viz.*, ontogenetic segregation and the time relationships of specific events. It is also inconsistent with his postulates of sex-genes which control, and therefore must react with, the greatest diversity of chemical processes in all parts of the organism, and of other genes similarly controlling diverse characteristics. Both conceptions postulate specific genes for all differentiating characters of each stage, and latency for all genes except those postulated for the specific event. In its essence the theory is deterministic, and not consonant either with sound physiology or sound genetics.

Apart from these conceptions I do not know of any sustained attempt to apply the modern theory of the gene to the problem of embryonic segregation. As the matter stands, this is one of the most serious limitations of the theory of the gene considered as a theory of the organism. We should of course be careful to avoid the implication that in its future development the theory of the gene may not be able to advance into this unconquered territory. But I do not see any expectation that this will be possible, even in principle, so long as the theory of the integrity of the entire gene system in all cells is maintained. If this is a necessary part of the gene theory, the phenomena of embryonic segregation must, I think, lie beyond the range of genetics.

Geneticists have, however, brilliantly demonstrated that genes are concerned in phenotypical realization at different stages of the life history, and it is therefore a reasonable postulate that this is true of all phenotypic realization. We come here, therefore, to the specific problems in which genetics and physiology of development really meet. There can be no reasonable doubt that any definable character whether of a morphological, physiological, or psychological (behavioristic) nature may be treated by methods of genetics (*i.e.*, considered statistically with reference to modes of recurrence in successive generations), as well as by methods of physiology. Thus in addition to the numerous morphological characters, for which they are already demonstrated, genes may also be posited of all physiological and behavioristic characters that can be shown to mendelize. Similarly there are genes for characters of the ovum and of the larva, and, by inference, there can be a complete genetics with corresponding genes for each stage of development.

The genetic problem thus differs from the embryological problem, inasmuch as any definable character at any time in the life history may be treated as final, according to the methods of genetics, and its genes presumably could be located on the chromosome map.

What then in the process of phenotypical realization would be the physiological status of the gene? Apart from analogical points of view in which for instance the action of genes is compared to that of enzymes, the approach to this problem may be made by two roads, (1) through experimental modifications of the environment of known genotypes and comparison of resulting phenotypes with control cultures, and (2) through comparison of the action of varieties of gene combinations on known characters of the organism.

Morgan, for instance, cites a mutant of Drosophila, studied by Mrs. Richards, differing from the normal by but a single gene, which when raised in an ice-chest has one or two, or even all, of its legs doubled, but if reared at room temperature none, "at room temperature no flies result with more than six good legs." In 1911 Baur cited several analogous cases in his text-book of heredity, and pointed out that in heredity in general what is inherited is not the character as such, but only a definite form of reaction to environment.

If this is a true generalization, the underlying postulate is again the ontogenetic substratum, which this form of analysis of the action of genes does not attempt to elucidate. What is won for physiology of development by such examples is a heightened sense of the dependence of physiological reaction upon the genetic foundations of the reacting system, but not additional insight into the developmental problem.[3]

The method of comparing the action of varieties of gene combinations upon known characters of the organism under constant or varied conditions of the environments is the oldest method of analyzing the mode of action of genes in development, and it appears to me to be the most promising method at the present time. The study of the phenomena of multiple allelomorphism, the observed results of gene deficiency resulting from loss of a piece or all of a chromosome, and the results following from triploidy or greater additions, whether of one chromosome or the entire chromosome complex, especially as presented by the Columbia University School of Geneticists, appear to me to throw much light on the problems of the physiology of development of the final

[3] Another form of environmental problem in genetics is found in attempts to modify the genes in the germ-cells directly, the indicator being the phenotypes resulting from such treated germ-cells compared with controls. This is, however, a problem in pure genetics and need not interest us farther.

terms of the underlying ontogenetic segregations. There is no time to rehearse these splendid additions to our biological knowledge, and I shall not attempt to appraise the theory of genic balance which appears so clearly to emerge.

More than this should, however, be said one can not imagine at the present time any other experimental technique that would even remotely approach in delicacy of treatment to the superlative refinement of modifications of the gene system that the genetic method renders possible. It is an indispensable method for phenotypical analysis whether in a genetic or a physiological sense.

Its scope is, however, limited in two ways. in the first place at whatever stage of development a character may be selected for examination, and whatever the nature of the character, it must always, so far as genetic method is concerned, *be treated as a finality* It has no past, except the genes postulated as a result of their appearance in previous generations—and no future The genetic method reveals, *alpha*, the gene, and *omega*, the final term The second limitation of genetics, considered as an approach to phenotypic realization is, of course, the failure of any direct physiological analysis of the postulated genes This need not be a permanent limitation, but it seems to me that *at the present time* it is a definite limitation

I suppose that geneticists would agree that there is a clear possibility that the future development of the subject may result in a considerable reduction of the number of genes necessary to be postulated Morgan's conclusions that a single gene may be concerned in a multiplicity of characters, both in time and in space, and that a multiplicity of genes may be concerned in each character are indeed steps towards simplification. But, granted the extremest simplification, genetics could at the most explain the special quality of characters associated with particular genes or combinations of genes at given stages and loci of development, but never why the same genes are associated with different characters at different stages and in different loci.

The present postulate of genetics is that the genes are always the same in a given individual, in whatever place, at whatever time, within the life history of the individual, except for the occurrence of mutations or abnormal disjunctions, to which the same principles then apply. The essential problem of development is precisely that differentiation in relation to space and time within the life-history of the individual which genetics appears implicitly to ignore.

The progress of genetics and of physiology of development can only result in a sharper definition of the two fields, and any expectation of their reunion (in a Weismannian sense) is in my opinion doomed to disappointment. Those who desire to make genetics the basis of physiology of development will have to explain how an unchanging complex can direct the course of an ordered developmental stream.

There remains to be mentioned the oft-noted phenotypic identity of environmental varieties of given characters and of genic modifications of the same characters One need only call to mind the bar-eye series in Drosophila or Johannsen's pure lines of beans Many similar cases exist in the phenomena of sex-differentiation, which appear to be conditioned by genes in insects, and hormones in birds, but which nevertheless exhibit comparable diversities and similar functions in the life history[4] How are we to understand this except on the assumption that both act on a given ontogenetic process?

Physiology of development and genetics both teach us the same lesson, *viz.*, that at the foundation of every phenotypic event there is an unanalyzed ontogenetic process, which expresses itself in time by qualitatively different types of reaction whether to the environment, or to the gene, or to both combined. This is the unrecognized presupposition of all studies in either field I must emphasize that there is nothing in the current principles of genetics or of physiology that gives us the least clue to the nature of embryonic segregation in its time sequence, which constitutes the ontogenetic process in its strictest meaning.

In this conclusion I find myself in agreement with Bateson, who, in his last publication, says:

"Cytology is providing some knowledge, however scanty, of the material composition of the cell, but of the nature of the control by which a series of orderly differentiations is governed we have no suggestion" (p 234), and again

"Throughout all this work, with ever-increasing certainty, the conviction has grown that the problem of heredity and variation is intimately connected with that of somatic differentiation, and that in an analysis of the interrelations of these two manifestations of cellular diversity lies the best prospect of

[4] The gene may of course be regarded as having secondary modes of action, to the extent that it is a factor in the realization of the intraorganic environment in all of its aspects If, for instance, we make the assumption that in birds the genic constitution determines the nature of the sex-hormones produced by the individual, then the known action of the sex hormones on head-furnishings, plumage, spurs, reproductive tract, growth and behavior may be regarded in a certain sense as secondary modes of action of the genes. But no example would serve better to show that both primary and secondary effects are functions of the life history as to their incidence.

success. Pending that analysis, the chromosome theory, though providing much that is certainly true and of immense value, has fallen short of the essential discovery" (p. 235).

However profound our present ignorance of the method of ontogenetic segregation may be we are nevertheless bound to conceptions of strict determinism concerning the phenomena involved. The phenomena of genetics and of embryonic induction exhibit strict experimental determinism, which would be impossible if the ontogenetic processes on which both depend were not deterministic also. Nothing that has been said in this essay should be interpreted in any contrary sense. The processes of embryonic segregation are open to observation and experiment equally with the processes of genetics and of embryonic induction My contention is merely that we have no present working hypothesis effective in this most fundamental aspect of the life history.

The dilemma at which we have arrived appears to be irresolvable at present. It is the apparent duality of the life history as exhibited in the associated phenomena of genetics and ontogeny: on the one hand the genes which remain the same throughout the life history, on the other hand the ontogenetic process which never stands still from germ to old age. It is no confession of weakness that we should admit our inability to form a picture of life-processes that have taken longer to evolve than the mobile crust of the earth itself. Instead of distorting our workable conceptions to include that which they can in no wise compass, may it not be profitable, for a while, to admit that more lies without than within our confines of mechanism and statistics? If physics and chemistry will not be complete until they have explained the action of their units in living matter, that is after all their affair Certain it is that physics and chemistry have no place among their categories for the ontogenetic process and *a fortiori* for the phylogenetic. Why not surrender ourselves, in consideration of these problems, to the current of more naïve biological categories?

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FRANK R. LILLIE

UNIVERSITY OF CHICAGO

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

NEWSPAPER REPORTS ON THE MEETINGS

It is commonly remarked that the general public, throughout the reading world, is increasingly interested in the progress of science. Practical achievements, such as inventions and directly useful discoveries, have long interested people not specially trained or engaged in scientific work, for such achievements affect the daily routine of ordinary life, but the last decade has witnessed a remarkable development of public interest in the more easily discussed aspects of scientific research and scientific progress. Intelligent people now wish to read about advances in knowledge that do not apply directly to their daily activities, and this desire seems to be rapidly spreading and becoming more intense. The technological or applied aspects of scientific progress remain, of course, the subjects of most popular discussion, and superficially descriptive science, including mere observational facts without discussion of relationships, naturally constitutes a large part of what is prepared for popular scientific reading.

All three of these different aspects of scientific knowledge — observational facts, applications that economize time or simply make life more pleasant or more gainful in the financial way, and theoretical or philosophical advances in interpretation or appreciation of relationships between objects of knowledge — are receiving much more popular attention than ever before. In this and many other countries writers for newspapers and magazines and for radio talks, and also those who have charge of museums, are increasingly occupied with the popular presentation of science material. Many writers are primarily so engaged; this sort of work is becoming an important branch of the teaching profession in a broad sense. The demand increases more rapidly than the supply, which may be taken to indicate that the reading public really desires all kinds of science material presented in simple fashion.

For many years the American Association for the Advancement of Science has tried to facilitate the popular reporting of its meetings, but it is only recently that its efforts have been met half-way by the

COLUMN-INCHES OF SPACE GIVEN BY EIGHT NEWSPAPERS TO REPORTS OF THE FIFTH PHILADELPHIA MEETING

	Sections	Philadelphia Evening Ledger	Philadelphia Public Ledger	Baltimore Evening Sun	New York Times	New York American	New York World	Boston Transcript	Christian Science Monitor	Total
A.	Mathematics				9 25	7 25	13 25			29 75
B	Physics	15	3 50	9 75	17 50	17.50	12	62 75	1 25	139.25
C.	Chemistry			4		1 50	1 50	6 50		13 50
D	Astronomy	6 25	23 75	24	17	32 50	41 25	23 25	11.25	179 25
E	Geol and Geog	26 75	21 50			2		12	30	92.25
F	Zool Sciences		14	21	32 25	3 75	1 25	21 50	1	94 75
G.	Bot Sciences		4 50	4 25	2 50		1 50	26 25	26	65
F–G	Additional zool and bot material, not separated			16	31	8 25	6	8 50	2	71 75
H	Anthropology		2 75	11 50	15	4 25		5 75	14	53 25
I	Psychology	6 75	9 50	17 50		11 50	5 50	34 75		85 50
K	Soc and Econ. Sciences	5 25	42.50	7 75	5	19 50	6	52 50	34	172 50
L.	Hist. and Philol Sciences		12 50		31.50		8	13 25		65 25
M	Engineering		8							8
N	Medical Sciences		5	6 25	7 50	7	8	51 25		85
O	Agriculture			1 75			2 50	12 50	13 50	30 25
	Education and Science in general	14.75	[illegible]7.75	3 50	7 25	16	6 75	16 25	42	194 25
	Total	74.75	235 25	127 25	175.75	131	113 50	347	175	1,379 50

news writers for the press At the great Chicago meeting in 1920 the few press representatives who were present were apparently not greatly interested in attempting to report the scientific material presented at that meeting. Those were times when editors seemed generally to desire amusing incidents and slap-stick comedy at the expense of science workers, and little energy was expended to present science in a popular way. The public had little opportunity to learn what science workers were trying to do Such an attitude on the part of the daily press aroused antagonism in the minds of the speakers at meetings of workers in science and made it more difficult for a news writer to secure useful material, even when that was attempted.

Beginning with the Toronto meeting in 1921, these conditions have changed rapidly and very thoroughly. Many of the most able writers of popular science have attended the recent meetings and have gone more than half-way in meeting the attempts of the association to get science and the scientific method of work before the public. Press reports of the meetings have become increasingly more thorough and more adequate. The antagonism of science workers has now largely disappeared and leaders in research are now generally willing to aid the representatives of the press in this important work At the same time, the association has put forth greater effort in this direction Hundreds of abstracts of papers to be presented at the meeting are secured beforehand from the speakers and are placed at the disposal of the representatives of the press, for release at proper times Arrangements are also made to facilitate the interviewing of science workers by press representatives. Photographs of prominent speakers are supplied to the press in many instances. A special news office has been made a part of the annual meeting, in charge of a news manager who represents the association.

Several of the great American daily papers usually have special representatives detailed to report the association meetings, representatives who are masters of the art of popular scientific presentation, and the same is true of several news agencies. Science Service, in the founding and operation of which the association has been specially interested, has been well represented at recent meetings and its work has been very helpful.

The last annual meeting, at Philadelphia, may be taken as an illustration of the present status of the

reporting of association meetings in the daily press and the data given in the following table will be of interest in this connection. This table has been prepared by Mr W. Eric Drake, of the Washington office of the association Eight leading newspapers that gave special attention to the meeting were selected and the amount of space given by each of them to news from the meeting, for each branch of science and for science in general, was determined in terms of column-inches. Illustrations were not included, they are generally half-tone reproductions of photographs of eminent men, though pencil sketches are sometimes used The results are the data given in the table, the names of the eight dailies being shown at the top The several fields of science are shown in the first column, referring generally to the sections of the association. But it will be noted that the F-G category includes material of zoology and botany that could not be readily separated Also, the last category of the list is, for the same reason, made to include both general science and the special field of education (Section Q). To avoid these combinations, which are perhaps not logically satisfactory, would have required more time and attention than seemed to be justified in such a little study as this.

Members of the association and of the associated societies who are interested in this aspect of the popularization or humanization of science will find interest in the fact that the permanent secretary's office now prepares regularly a scrap-book of newspaper clippings for each annual meeting, each slipping being marked to show the name and date of the paper in which it appeared. The clippings are attached to strong sheets, which are finally bound in permanent form These scrap-book volumes may well be of considerable interest as time goes on. They form a part of the association archives. Any one who cares to examine the scrap-books may do so at the Washington office at any time.

Turning to the table of measurements of space given by the newspapers to reports of the fifth Philadelphia meeting, it will be noticed that all eight papers together devoted nearly 1,400 column inches to the sessions The largest space (347 in) was given by the Boston *Transcript* and the next largest (235 in.) by the Philadelphia *Public Ledger*. As to the amounts of space devoted to the association sections by all papers together, it appears that Section D (Astronomy) was most generously treated and that nearly as much space was devoted to the programs of Section K (Social and Economic Sciences) Section B (Physics) received a large amount of space If zoology and botany were combined (items F, G and F-G in the table) the resulting total (282 in.) would be larger than any other in the table, but the separate items are not very large.

If one studies the general program of the meeting it becomes clear that at least three factors take part in determining the amount of space devoted to any branch of science: the number of papers presented in the given branch, the adaptability of the material presented, with reference to popular accounts such as are suitable for newspaper publication, and the degree of reportorial or editorial interest in the given branch The figures given in the table are not to be taken to represent any single one of these factors, but in some cases one factor appears to have dominated while in other cases another factor seems to have been most pronounced. Mathematics is perhaps least adaptable to popular presentation and only three of the dailies attempted to do anything with this field On the other hand, all of the eight dailies dealt with physics and astronomy as well as with social and economic science. Special editorial interest, or lack of interest, in certain fields appears to be indicated in some cases.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENTIFIC EVENTS

RESEARCH FELLOWS AT YALE UNIVERSITY

INVESTIGATIONS into scientific and literary problems are being made this year under Yale University auspices in Greece, England, Scotland, Germany, Austria, Belgium, Russia and Africa, according to an announcement by Dean Wilbur L. Cross, of the Yale Graduate School.

Eight holders of Sterling fellowships, the funds for which were provided by the trustees of the estate of John W Sterling, are carrying on their work abroad. These include: Dr. Hempstead Castle, who is in Europe collecting material for a world monograph of the known species of radula; Dr Filmer Stuart Cuckow Northrop, who has been studying in Berlin and Zurich the generalization beyond the general theory of relativity, and Dr. Prescott Wilson Townsend, who has been continuing his archeological research in northern and western Africa.

John Wynn Gillespie, M A., Stanford University, and Victor Pietschmann, University of Vienna, who are the holders of Bishop Museum Fellowships, are conducting research in botany and zoology in the islands of the Pacific. Mr Gillespie is concentrating on the Fiji and Samoa Island groups, and Dr. Pietschmann on the New Hebrides and Loyalty Islands.

Six of the scholars awarded Sterling fellowships

for research at Yale University this year are of foreign birth. These include Dr. Blythe A. Eagles, of the University of Toronto, who is conducting research in biochemistry; Amihud Crasovsky, of Jaffa, Palestine, a graduate of the University of California, who is in the department of botany; Catherine L. T. Lucas, B.Sc., University of London, M.Sc., London School of Tropical Medicine and Hygiene, who is in the department of zoology, Paul Slavenas, of the University of Lithuania, Kaunas, Lithuania, who is conducting research in astronomy, and Desire T. Veltman, of the University of Holland, of Dutch citizenship, who is in the department of philosophy. Mr. Dirk Brouwer, who is assistant at the observatory at Leiden, Holland, is doing work in astronomy at Yale.

The Lilly research fellowship in organic chemistry has been awarded this year for the first time. The recipient is Dr. Richard Helmuth Fred Manske, Ph.D., Manchester University, England, 1926. Dr. Manske is conducting research in organic chemistry under Professor Treat B. Johnson.

Among the visiting memb[illegible] the faculties of other institutions who are ma[illegible] of the facilities of the university are, Profe[illegible]mi Eri, of the Higher School for Women, [illegible] Japan, who is working under Professor [illegible] Harrison in the department of zoology; Prof[illegible]r C. C. Chen, Ph.D., Yale, of Shanghai College, who is undertaking special research in bacteriology, and Miss Isabella Gordon, Ph.D., University of London, from Scotland, is doing research work in zoology and anatomy.

PUBLIC LECTURES ON ASTRONOMY

A SERIES of five "Open Nights," under the auspices of the Bond Astronomical Club, are being held at the Harvard College Observatory. A short non-technical talk is followed, when the weather permits, by telescopic observations of celestial objects. Exhibits showing the work of the observatory are explained by members of the club. Tickets for these open nights must be obtained in advance. There is no charge for admission. The lectures begin at 7:45 P.M. The dates, titles of lectures and the speakers are as follows:

Oct. 10.—*The full moon and the eclipsed moon.* Dr. W. J. Fisher.

Oct. 13.—*The winter constellations.* Dr. Cecilia H. Payne.

Oct. 18.—*The planets.* Mr. Leon Campbell.

Oct. 24.—*New stars.* Dr. Annie J. Cannon.

Oct. 27.—*Star clouds and nebulae.* Professor Solon I. Bailey.

The Astronomical Society of the Pacific has arranged two series of lectures for the coming season, one of six lectures at Culbertson Hall, Pasadena, and one of six lectures at the Public Library, Los Angeles. All of these are free to the public, although tickets, which may be obtained at the office of the Mount Wilson Observatory, will be needed for admission to all lectures in Culbertson Hall. All the lectures are to begin at 8:00 P.M. The subjects, dates and lecturers are:

Culbertson Hall, Pasadena

Sept. 29.—*Sun rays in the service of man.* Dr. C. G. Abbot.

Oct. 27.—*The exploration of space.* Dr. E. P. Hubble.

Nov. 17.—*Sun-spots.* Dr. S. B. Nicholson.

Dec. 15.—*Stars in action.* Professor A. H. Joy.

Jan. 26.—*How stars are made.* Dr. H. N. Russell.

Feb. 24.—*Our planet neighbors.* Dr. R. G. Aitken.

Public Library, Los Angeles

Dec. 15.—*Telescopes.* Dr. F. G. Pease.

Jan. 19.—*The sun.* Professor F. Ellerman.

Feb. 23.—*The solar system.* Dr. R. G. Aitken.

March 23.—*Giant and dwarf stars.* Dr. F. C. Leonard.

CHANGES IN THE ORGANIZATION OF THE U. S. BUREAU OF STANDARDS

AN important change in the administrative organization of the U. S. Bureau of Standards, which it is believed will make for increased efficiency through a better grouping of the bureau's numerous activities, has been announced by the director, Dr. George K. Burgess.

Under the new arrangement, Dr. L. J. Briggs has been appointed assistant director in charge of research and testing, while Ray M. Hudson becomes assistant director in charge of commercial standards.

The regrouping is a recognition of the importance of standardization in the commercial world, this portion of the bureau's work having grown with great rapidity during the last few years.

As stated above, the bureau's activities will be divided into two main groups. The first, under the immediate supervision of Dr. Briggs, will include all the bureau's scientific research and testing, the development, construction, custody and maintenance of reference and working standards and their intercomparison, improvement and application in science, engineering, industry and commerce.

The second group, headed by Mr. Hudson, will include the supervision, direction, formulation and coordination of commercial standards, with particular reference to the needs of industry, involving the oversight of the division of simplified practice, division of commercial standards and part of the work of the division of building and housing relating to codes and

standards. In addition, the correlation of the work of the federal specifications boards with commercial practice, and liaison duties with other branches of the Department of Commerce and with other departments in questions relating to commercial standards will be included in this group

Dr. Briggs will act as executive head of the bureau when the director is absent in the management and supervision of the administration, scientific and technical work He will also continue as liaison officer on matters of aeronautics between the Bureau of Standards, the aeronautics branch of the Department of Commerce and other branches of the government

DIVISION CHAIRMEN OF THE NATIONAL RESEARCH COUNCIL

The following chairmen of divisions of the National Research Council have been appointed for the current academic year:

Division of Federal Relations, George Otis Smith, director, U S Geological Survey.

Division of Foreign Relations, R A Millikan, director, Norman Bridge laboratory of physics, California Institute of Technology, Pasadena.

Division of States Relations, Raymond A Pearson, president, University of Maryland

Division of Educational Relations, Vernon Kellogg, permanent secretary, National Research Council

Division of Physical Sciences, Dayton C Miller, professor of physics, Case School of Applied Science.

Division of Engineering and Industrial Research, Elmer A. Sperry, president, Sperry Gyroscope Company, Brooklyn, New York.

Division of Chemistry and Chemical Technology, Frank C Whitmore, professor of chemistry, Northwestern University

Division of Geology and Geography, Waldemar Lindgren, professor of economic geology, Massachusetts Institute of Technology

Division of Medical Sciences, Howard T Karsner, professor of pathology, Western Reserve University

Division of Biology and Agriculture, William Crocker, director, Boyce Thompson Institute for Plant Research, Yonkers, New York

Division of Anthropology and Psychology, Knight Dunlap, professor of experimental psychology, the Johns Hopkins University

SCIENTIFIC NOTES AND NEWS

The Harben gold medal of the Royal Institute of Public Health for 1928 has been awarded to Sir Ronald Ross in recognition of his eminent services to public health.

The Morris Liebmann memorial prize of $500, for 1927, has been awarded to Dr A Hoyt Taylor, of the Naval Research Laboratory, in Washington, according to an announcement by Dr. Ralph Bown, president of the Institute of Radio Engineers, at a meeting of the institute held in the Engineering Societies' Building, New York, on October 4.

The Helen Culver gold medal of the Geographic Society of Chicago has been awarded to Dr Gilbert H Grosvenor, president of the National Geographic Society and editor of its magazine The medal is for eminent accomplishments in the promotion of geography.

In recognition of his scientific work in the domain of pathology, Dr. Louis B. Wilson, of the Mayo Clinic, has been elected an honorary member of the Czech Medical Society of Prague This society was founded by the famous physiologist, J. E Purkinje, who was its president until his death in 1869

Dr Edward R. Weidlein, director of the Mellon Institute of Industrial Research, University of Pittsburgh, has been elected an honorary member of the Chemical, Metallurgical and Mining Society of South Africa.

Nature states [illegible] the course of the Congress of the Institut Int[illegible]l d'Anthropologie, which was held at Amster[illegible] September 20 to 27, it was announced that [illegible]x Hollandais of the institut had been awarded [illegible]iss Dorothy A E Garrod in recognition of her work in prehistoric archeology, and especially for her excavation of the cave at the Devil's Tower, Gibraltar

Professor Vittorio Ascoli, director of the Clinica Medica of Rome, has received from the University of Edinburgh the degree of doctor *honoris causa*.

Professor Forest Ray Moulton, director of the department of astronomy of the University of Chicago, has resigned to become associated in an executive capacity with the Utilities Power and Light Corporation of Chicago.

Dr. Montrose T. Burrows has resigned as head of the research department of the Barnard Free Skin and Cancer Hospital.

C F. Marbut, in charge of soil survey work, U. S. Bureau of Chemistry and Soils, has been appointed a member of the interbureau corn-borer committee by Dr. A. F. Woods, director of scientific work. This committee, whose object it is to determine what aid the various bureaus of the department may give in the corn-borer control work, includes representatives of the Bureaus of Plant Industry, Public Roads, Animal Industry, Agricultural Economics, Dairy Industry, Extension Service, Chemistry and Soils and Entomology.

At Yale University, Professor Richard S Lull, professor of paleontology and director of the Peabody Museum, has been appointed to fill the new Sterling professorship in paleontology, and Professor Ross G Harrison, Bronson professor of comparative anatomy and director of the Osborn zoological laboratory, has been appointed to the Sterling professorship in biology These appointments fill the new Sterling chairs given to the university recently by the trustees of Mr Sterling's estate Dr Francis G Blake, the John Slade Ely professor of medicine, becomes Sterling professor of medicine, succeeding Dr Edward A. Park, who recently resigned

Dr Rufus Cole, director of the hospital of the Rockefeller Institute for Medical Research, has been appointed to membership on the New York Commission on Ventilation, of which Dr C-E A Winslow, professor of public health in Yale University, is chairman

Dr Carl Ten Broeck, professor of bacteriology at the Peking Union Medical College, China, has been elected a member of the board of [illegible]entific directors of the Rockefeller Institute for M[illegible]esearch.

Dr. John A Hartwell ha[illegible]osen a trustee of the New York Academy of [illegible] for the unexpired term of the late Dr Wa[illegible]ames.

Dr. H. E Barnard, presiden[illegible] the American Institute of Baking, has resigned. Mr. Henry Stude, president of the American Bakers' Association, has been asked by the chairman of the board of directors to serve as temporary head

Dr Albert R Merz has been elected president of the Washington, D C, chapter of the American Institute of Chemists, to fill the unexpired term of Professor Paul H Brattain, resigned

Dr. Henry G Knight, dean of the college of agriculture and director of the experiment station of the University of West Virginia, Morgantown, who was recently appointed by Secretary Jardine as chief of the new Bureau of Chemistry and Soils, was formerly inducted into office on October 1.

Raymond T. Parkhurst, head of the poultry department of the University of Idaho Experiment Station, has been appointed director of the National Institute of Poultry Husbandry at the Harper Adams Agricultural College, Newport, England, rendered vacant by the resignation of Professor Willard C Thompson in 1926.

Geo. Hume Smith has recently resigned his instructorship in botany at the University of Illinois to become a member of the staff of *Biological Abstracts*, the headquarters of which are at the University of Pennsylvania.

Charles J Stuckey, who held the Porter fellowship of the American Physiological Society for the year 1926–1927, has accepted a position as research chemist at the research laboratories of Scott and Bowne, Bloomfield, N J.

Dr. John Boswell Whitehead, professor of electrical engineering and dean of the school of engineering at the Johns Hopkins University, has returned from France, where he was serving as exchange professor in engineering and applied science during the past academic year. He visited the universities of Aix-Marseille, Grenoble, Lyon, Bordeaux, Toulouse, Caen, Lille, Strasbourg, Nancy and Paris, in each of which he delivered a series of lectures on dielectric theory and insulation. In Paris the lectures were delivered at the Sorbonne and at the Ecole Supérieure d'Electricité The University of Nancy conferred on Dr Whitehead its medal of honor.

Professor Charles E. Decker, paleontologist of the University of Oklahoma, Professor Leslie Spier, head of the department of anthropology, and Dr Chas N Gould, director of the Oklahoma Geological Survey, recently visited the gravel beds near Frederick, in southwestern Oklahoma, which have recently yielded human artifacts found in connection with mammalian bones of early Pleistocene or late Pliocene age. The party was successful in discovering a section about three by five feet in size of the top part of the carapace of the ground sloth, Glyptotherium

Dr. W F Foshag, of the division of mineralogy, U S. National Museum, has returned after four months spent in the mining regions of Mexico, particularly in the states of Guanaguato, Zacatecas, Chihuahua, Durango and Sonora. Some thirty-five boxes of specimens, the result of the trip, have been received at the museum

Professor Harry N Eaton, of the department of geology, of Syracuse University, has returned after a year's leave of absence spent studying the structure of the smaller mountain ranges of the desert west of the Rocky Mountains

Commander George Miller Dyott, who returned last spring from a trip of exploration along the River of Doubt in Central Brazil, is forming a new expedition to start in a few weeks for the unexplored jungle south of the Amazon.

Professor Hans Cloos, head of the department of geology of the University of Bonn, has been spending several weeks in America studying North American mountains. After having spent some weeks in the mountains of California and Nevada, studying especially the granite masses of the Yosemite valley, Dr. Cloos visited Oklahoma in order to familiarize himself

with the type of folding in the Arbuckle and Wichita Mountains

IN the last few weeks a number of eminent poultry authorities from various parts of the world, who attended the recent world poultry congress at Ottawa, Canada, have visited the United States, according to the *Official Record* of the U S Department of Agriculture, including Professor Salvator Castello, head of poultry work in Spain, Professor H Ogiware, expert, Imperial Zootechnical Experiment Station, Chiba-shi, Japan, Professor E. T. Halnan, in charge poultry nutrition work, University of Cambridge, England, Dr Fritz Pfenningstorff, Berlin, Germany; Dr C. H Van Gink, Voorburg, Holland, Professor Hugo Medina, Chilean Experiment Station, Santiago, Chile, and Captain Washington, England.

MISS M BLACKETT, an investigator of the National Institute of Industrial Psychology of Great Britain, has been awarded a Laura Spelman Rockefeller Memorial Fellowship, and plans to spend a year in the study of psychology in the United States.

DR. H C SAMPSON, of the Royal Botanical Gardens at Kew, London, is visiting Jamaica, under the auspices of the British Empire Marketing Board, in connection with plans to improve the products of the region

DR. EDWARD FRANCIS, surgeon, of the Hygienic Laboratory of the United States Public Health Service, will deliver the first Harvey Society lecture at the New York Academy of Medicine on November 11. His subject will be "Tularemia."

DR ALONZO TAYLOR, director of food research at Stanford University, gave the Carpenter lecture at the New York Academy of Medicine on October 20 Dr Taylor spoke on "The Present and Future Food Supply of the United States"

DR RICHARD B MOORE, dean of science at Purdue University, will address the regular meeting of the Chicago section of the American Chemical Society on October 21 on "The Story of Helium."

DR. EVARTS A. GRAHAM, professor of surgery at the Washington University School of Medicine, St. Louis, has been selected to deliver the Shattuck lecture before the Massachusetts State Medical Society at Boston in 1928.

SIR WILLIAM BRAGG will deliver a lecture on "Crystallization" at the opening meeting of the 1927-28 session of the Institution of Chemical Engineers on October 28

THE Huxley lecture will be delivered at Charing Cross Hospital Medical School on November 24 by Sir Archibald Garrod, Regius professor of medicine in the University of Oxford, on "Diathesis."

A COMMITTEE has been formed to prepare a memorial to Dr. Thomas W. Salmon, professor of psychiatry at Columbia University, and the first medical director of the National Committee for Mental Hygiene, who in August drowned while sailing on Long Island Sound.

THE Institute of Tropical and Preventive Medicine, Chicago, has issued an appeal for funds to establish a Gorgas Memorial as a tribute to William Crawford Gorgas. President Coolidge has approved of the memorial plan and is honorary president of the proposed institute in memory of Mr. Gorgas. It is proposed to raise an endowment fund of at least $5,000,000

WALTER REED MEMORIAL COMMISSION of the Medical Society of Virginia for the Encouragement of Research will dedicate as a national shrine at Belroi, Gloucester County, Virginia, the birthplace of Walter Reed

A MEMORIAL window in memory of Dr. Francis D. Kelsey, profe[illegible]botany at Oberlin College from 1893 to 1897,[illegible] placed in the First Congregational church[illegible]o.

As already[illegible]SCIENCE, a committee has been formed for th[illegible] of raising funds and erecting a monument to [illegible]e Dr. Fritz Müller, the well-known Brazilian naturalist. The monument is to be executed by the sculptor, F W. Lobe, and will be placed at Blumenau, State of Sta Catarina, Brazil, where Dr Müller spent the greater part of his life Members of the committee are: Dr Victor Konder, minister of public roads, Dr. J. Boiteux, honorary president; Kurt Hering, president, Dr. Amadeu Luz; Otto Rothkohl, German consul; August Zittlow; Hans Lorenz and Conrado Balsini. Contributions are desired from American scientific men These may be sent to Banco Germanico, São Paulo, Brazil, or to Dr. Waldo L. Schmitt, Smithsonian Institution, who will be glad to acknowledge and forward them.

DR. FRANCIS WELD PEABODY, professor of medicine at Harvard University, died on October 13, aged forty-five years.

DR. FREDERICK LEONARD WASHBURN, professor of economic vertebrate zoology at the University of Minnesota, and state geologist from 1902 to 1918, died on October 15, aged sixty-seven years.

PROFESSOR A LIVERSIDGE, F.R.S, emeritus professor of chemistry in the University of Sydney, died on September 26, aged seventy-nine years.

M. EMILE HAUG, *membre titulaire* of the section of mineralogy of the Paris Academy of Sciences, professor of geology at the Sorbonne and a past-presi-

dent of the Geological Society of France, died on August 28, aged sixty-six years.

The one hundred and forty-seventh regular meeting of the American Physical Society will be held in Chicago, at the Ryerson Physical Laboratory, on Friday and Saturday, November 25 and 26.

The American Psychological Association will hold its annual meeting at the Ohio State University, from Wednesday to Friday, December 28, 29 and 30, under the presidency of Dr Harry L. Hollingworth, of Barnard College, Columbia University.

The twenty-third annual meeting of the American Society of Tropical Medicine will be held in Boston, on October 21 and 22, in the amphitheater of building E, Harvard Medical School. Dr. George C. Shattuck, of the Harvard Medical School, is the president of the society

With the opening of the 1927–28 session, the British Institute of Metals takes possession of its new headquarters, which include an additional library and reading room, at 36 Victoria Str [illegible] don.

At its recent annual meeting i [illegible] gh, the representative body of the Britis [illegible] Association approved the recommendation [illegible] cal to hold the annual meeting in 1930 i [illegible] eg, Canada. The annual meeting in 1929 w [illegible] in Manchester, England. At the Edinburgh meeting, Sir Robert W Philip, professor of tuberculosis, University of Edinburgh, and honorary physician to the king at Scotland, was inducted into office as president of the association for 1927–28 Sir Ewen McLean, gynecologist at the Cardiff Infirmary, was made president-elect, Dr. Charles O. Hawthorne, chairman of the representative body, and Mr Bishop Harman, treasurer.

The Australasian Association for the Advancement of Science will meet at Hobart, Tasmania, in January, 1928.

At the meeting of the International Horticultural Congress, which recently closed its sessions in Vienna, it was decided to refer the question of the creation of an independent bureau for congresses to the International Institute for Agriculture at Rome Great Britain's invitation to hold the 1930 congress in London was unanimously adopted.

The Kaiser-Wilhelm Institute for Anthropology was inaugurated in Berlin-Dahlem on September 15 by Herr von Harnack, the president of the Kaiser-Wilhelm Gesellschaft. Professor Eugen Fisher, the director of the new institute, outlined the program In addition to the anthropological department, there are others devoted to heredity and eugenics.

According to *Museum News*, the North Sea aquarium of the State Biological Institute on the island of Helgoland has recently been opened to the public. The aquarium has about fifty large tanks and shows the complete fauna and flora of the North Sea

Opening exercises of the second session of the school of tropical medicine of the University of Porto Rico, under the auspices of Columbia University, were held on October 3 in the assembly room of the school. Dr Henry J. Doerman, acting chancellor of the University of Porto Rico, spoke on the rôle of the school as a graduate department of the university. The director, Dr R. A Lambert, gave an address on "Modern Tendencies in Medical Education" Dr. Pedro N Ortiz, commissioner of health and professor of hygiene and transmissible diseases, presided.

Louis B Kuppenheimer has contributed the sum of $250,000 to the University of Chicago to establish "The Louis B and Emma M Kuppenheimer Foundation" The income derived from this fund is to be devoted to the study of the structure, functions and diseases of the eye, and to the support of the clinical, research and teaching activities of its department of ophthalmology

Dr. G A Talbert, head of the department of physiology at the University of North Dakota Medical School, was a recipient of a grant of $300 the past year from the American Medical Association Research Fund With this aid Dr Talbert and his students were able to further pursue their research on the study of the constituents of the sweat, urine and blood, also gastric acidity and other manifestations resulting from sweating.

According to the Italian correspondent of the *Journal* of the American Medical Association, the institute of general pathology of the University of Genoa recently received a legacy of several million liras from the estate of Dr. Mangiamarchi, who died at Pretoria, Transvaal By testamentary provision, the bequest must be devoted to the development of the new institute that was opened last year

On September 24 the R. R. S. *Discovery* anchored in Falmouth Harbor, England, having completed a two years' cruise to Cape Town, South Georgia and the Falkland Islands; she was expected to arrive in the Thames on October 1. The primary object in fitting out the *Discovery* expedition was the investigation of the southern whaling fisheries. It is expected that the scientific staff will spend some months ashore working up the results of the expedition, and that these will prove of great value to science and to the whaling industry.

Dr. Ludlow J. Weeks, of the Canadian Geological Survey, Department of Mines, and an assistant, Mr Maurice H Haycock, of Wolfville, Nova Scotia, accompanied the 1926 Canadian Arctic expedition as far as Baffin Island and returned on this year's patrol ship After establishing headquarters at Pangnirtung in 1926 several trips were made around the head of Cumberland Gulf and a plane-table map of Pangnirtung fiord was completed before the 1926–27 winter set in. During the winter and the following spring approximately 2,300 miles were covered by sled and dog team By this means the party was able to map the northern part of Cumberland Gulf, and in the spring, to investigate the geology and mineral possibilities of the region. Early in May the party moved to Nettilling fiord and, after the break-up in July, a start was made on the journey by water to Nettilling Lake. The party succeeded in carrying a traverse from Nettilling fiord through a chain of small lakes to Nettilling Lake and along the south shore of the latter.

UNIVERSITY AND EDUCATIONAL NOTES

By the will of the late Annie Downing Willson, of Cambridge, the sum of $150,000 is left in trust to Harvard University, the income of which is to be used to maintain a professorship of applied astronomy in the university.

The will of Robert Forsyth, consulting engineer of Chicago, bequeaths $100,000 to the Rensselaer Polytechnic Institute of Troy, N Y

The University of Rochester will receive from the estate of James M Cutler, former mayor, property valued at $2,407,151, to be used as a permanent endowment $55,486 41 was set aside by Mr Cutler for the College of William and Mary at Williamsburg, Va

Dr G Carl Huber, professor of anatomy and histology in the University of Michigan since 1892, has been made dean of the graduate school of the University of Michigan, succeeding the late Professor Alfred H Lloyd, who died last spring

Dr A W Stearns has been appointed dean and associate professor of neurology at the Tufts Medical School

Dr Charles Allen Porter, John Homans professor of surgery at the Harvard Medical School, has resigned. Dr Porter's successor will be Dr. Edward Peirson Richardson, now assistant professor of surgery in the school

Professor J R. DuPriest, head of the department of mechanical engineering at Oregon State College, recently accepted a similar position at the University of Minnesota.

Dr. L. B. Nice has resigned as professor of physiology at the University of Oklahoma, in order to accept an appointment as professor of physiology at Ohio State University

Professor I M. Kolthoff, of the University of Utrecht, Holland, has been appointed professor of analytical chemistry at the University of Minnesota for the coming year He is to replace Professor P H M P. Brinton, who recently resigned to do private work

Dr Leon H Strong, formerly assistant professor of anatomy at the University of Indiana, has been appointed associate professor of anatomy at the University of Utah School of Medicine. Dr O A. Ogilvie (M D, Penn. '27) has been appointed assistant professor of anatomy and pathology in the same school

Dr. Noel F Shambaugh, former fellow in medicine of the Natio[illegible]earch Council, upon his return from Berne, [illegible]and, was appointed assistant professor of cl[illegible]estigation in the department of internal me[illegible]e University of Michigan.

Dr Will[illegible] Graham, instructor in geology at the Unive[illegible] Iowa, has been made associate professor of geology at Texas Technological College Dr M A Stainbrook, instructor in the University of Tennessee, has been made assistant professor of geology in the college.

Dr William H. Adolph, formerly of Chee-Loo University, China, last year at Yale University, has been appointed to an associate professorship of chemistry in the University of Nebraska.

DISCUSSION AND CORRESPONDENCE

A SUGGESTION OR HYPOTHESIS CONCERNING THE ZODIACAL LIGHT

The nature or origin of the zodiacal light is regarded as more or less of a mystery. Some have thought that the phenomenon may indicate the existence of a diffused ring of small particles in equilibrium and in nature somewhat like those of Saturn's rings, though more scattered and existing in very small amount compared thereto.

This hypothesis assumes a stability which it is difficult to accord to such a ring.

If we assume, however, that the coronal streamers from the sun which apparently extend without limit of distance into space, as partly composed of or accompanied by fine particles propelled by the pressure of light, or even of fine solids from condensation

of vapors arising from the solar atmosphere and expanding into a vacuum external thereto, we may form a hypothesis which seems to be consistent with the facts. The fine condensed particles would move into a vacuous space in substantially straight lines and would reach enormous distances from the solar body. As the spectrum lines of iron are prominent in solar light, it might be expected that in the space surrounding the sun fine particles of iron would constitute, in part, at least, those escaping streamers from the solar atmosphere. These particles would surround the earth and be extended in all directions therefrom.

If they be of the same or of similar nature to those which in my experiments are seen to line up in a magnetic field (the observations on the novel magneto-optical effect described in SCIENCE, June 24 and July 29, 1921) then the zodiacal light, which is seen best at places near the equator and at times of vernal and autumnal equinoxes, might be explained as follows The magnetic field lines of the earth joining the north and south areas outside the earth would, at the equator, lie sensibly parallel to the earth's axis but at a great height, on the average, above the surface of the earth. This is illustrated in the subjoined figures, which indicates the general trend of the earth's magnetic field (one side only) all around the earth in the space about it.

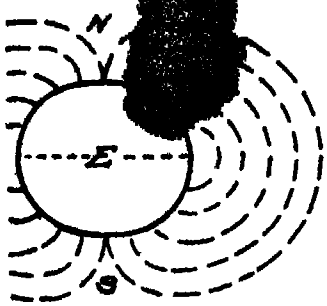
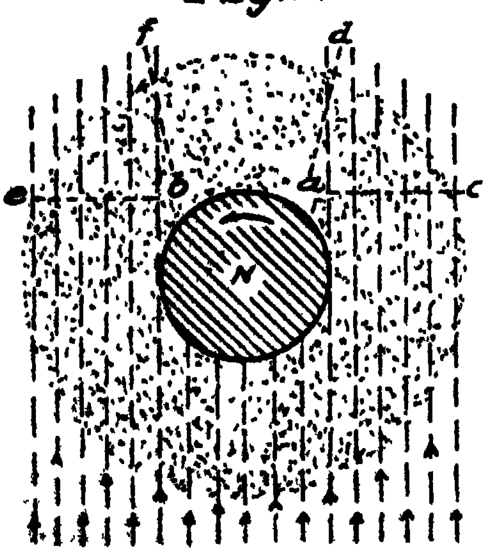


Fig.

Fig. 2.



The dots in Fig. 2 do not represent floating particles, but are intended to show only that if one could look at a pole of the earth from a great distance and see a section through the equatorial plane, the lines of force of Fig. 1 might be indicated as dots in the equatorial plane Now, let the sun's rays be from below, it will be seen that they intersect the direction of the magnetic lines at nearly right angles. Now, further, let us by some means render visible in the polar beam the magnetic field about the earth, it will become apparent that it will be best seen by observers after twilight at night and before twilight in the morning—best at the time of the equinoxes and best in the tropical night On the average the observer placed at about *a* or *b* looking upward, will be well placed for such observation and the column of light will extend from *c* to *d* on the evening side, and from *e* to *f* on the morning side, or over an angle of about 60° altitude, more or less.

It may, therefore, appear as a plausible hypothesis that the luminous effect known as the zodiacal light or the "Gegenschein" may be of the same nature as that observed in the combination of magnetic field, light beam and iron smoke from an arc, as described in 1921 in SCIENCE, as above If the zodiacal light is polarized in the same way as the light from the iron smoke is polarized and undergoes the same variations by variations in the direction of viewing it, these circumstances might assist in identification.

There has been no opportunity to make any observations on this point. As the luminosity of the zodiacal light is low, although coming from a great depth of space around the earth, there would not need to exist for producing the effect more than an exceedingly small density in the iron particles concerned, a density perhaps millions of times less than in my original experiments on the magneto-optical effect. It has been shown also that the orientation which is the cause of increased luminosity in the light beam is producible by a very weak magnetic field. That the direction of viewing is transverse to that of the light beam, and that the magnetic field lines are transverse both to the directions of viewing and light beam, are significant facts. More and varied observations and experiments are certainly warranted in this fascinating field.

It will be seen that the hypothesis presented does

not require any ring formation around the earth. It requires only that the general space surrounding the sun and planets contain an exceedingly small density of diffused iron particles, capable of being affected or oriented when in the magnetic field surrounding the earth, in which case they reflect the light of the sun to observers on the earth who are in favored relation to them Moreover, it may well be that the magnetism of the earth would tend to concentrate such iron particles, if any, in the space around it If we have found a clue to the observed effects, further observations and investigations may confirm or oppose the hypothesis presented

ELIHU THOMSON

LYNN, MASS

THE PHYSICS QUADRILATERAL

ONE of the joys of a teacher in a university is the weekly colloquium or departmental meeting in which by cooperation he is able to keep fairly well informed as to the work that is being done in his special line In the average American college, however, where the teachers are few and the duties numerous, a weekly or even a monthly colloquium is hardly practicable. Especially is this true in a subject like physics, where a considerable mathematical equipment is necessary, and consequently the reading of an average article in a physical journal is laborious and often impossible for a college student. So his contribution to a colloquium is nearly negligible and most of the burden falls on the professors. The natural result is that the colloquium idea is given up and the few members of the physics staff despair of being able to keep in touch with what is going on.

To remedy such a condition in this vicinity the following plan was adopted two years ago The teachers of physics in the four colleges, Mount Holyoke, Smith, Massachusetts Agricultural and Amherst, established "The Physics Quadrilateral" President Olds, of Amherst, who had studied under Helmholtz, Kirchhoff and Quincke, was added to our membership The first meeting was held at Amherst and was addressed by Dr. Gladys A Anslow, of Smith A discussion followed and then refreshments. Other meetings were held in rotation at intervals of about a month at the other colleges The Quadrilateral's only officer is a secretary, and the program is usually arranged by the department of the college at which the meeting is held The feature of one of our recent meetings was an address by Professor Louis V. King, of McGill University, on "The Gyromagnetic Electron and a Classical Theory of Atomic Structure and Radiation" The final meeting of the first year took the form of an excursion to the high-tension laboratory and plant of the General Electric Company at Pittsfield.

It is scarcely necessary to add that The Quadrilateral is a source of benefit and pleasure to all its members, and this communication is written that other colleges similarly situated may pool their resources and reap similar reward.

JOSEPH O THOMPSON

AMHERST COLLEGE

THE POISONING OF HONEY BEES BY COMMON ORCHARD SPRAYS

RECENT studies made by the Massachusetts Agricultural Experiment Station have indicated that there is little danger of significant mortality of honey bees from the spraying of orchards, provided that the recommended combination of lead arsenate, lime-sulfur and nicotine sulfate is used

In laboratory tests, bees were strongly repelled by this regular spray combination (lead arsenate, 1½ lbs to 50 gals, lime-sulfur, 1 40; and nicotine sulfate, 1 1,000). This mixture, however, even when consumed in minute amounts, proved to be very toxic to them and was [illegible]id in its killing action. Lead arsenate spra[illegible]adily accepted A one-frame nucleus to wh[illegible]was offered lost approximately one half of [illegible]within forty-eight hours after feeding An[illegible]ontaining nicotine sulfate was very repellent[illegible]s, and they would feed upon it but sparingly [illegible] strong repellent action persisted for a considerably longer period in the laboratory than in field tests, and appeared to vary according to the volatilization of the nicotine.

Under Massachusetts conditions, the orchard sprays applied nearest the period of bloom are the pink and the calyx. No sprays are scheduled to be made when trees are in full bloom Neither of these sprays, made when there was considerable bloom on the trees, caused any serious mortality to colonies located in the sprayed orchards. Following the late pink, trees soon came into full bloom; after the early calyx, the bees repelled by the spray doubtless foraged in neighboring orchards. In both cases they found an abundance of unpoisoned bloom upon which to work This would indicate that improper spraying must be carried out on a large scale to visibly affect colonies not subject to any restrictions of flight.

A. I. BOURNE

MASSACHUSETTS
AGRICULTURAL COLLEGE

ACOUSTICS IN THE STUDY OF "SOLUTIONS"

WHILE stirring a dose of Epsom salts in water for a patient I noted that if I strike the container (a glass) with the mixer (a glass rod) at regular intervals until the solute is entirely dissolved, each stroke

will emit a musical note which at first with each succeeding note will become lower I usually count four or five notes—less than an octave. When a certain point in the solution is reached the reverse takes place, namely, that the musical notes will become higher and higher until the solute is entirely dissolved or reaches a point of saturation I repeated the experiment a number of times and found that between the first contact of the above solute with the solvent until solution or saturation has been effected I could distinguish a change in the scale about three or four octaves. Salt, sodium citrate and ammonium chloride will produce the same effect while undergoing solution. Sugar and sodium phosphate does not produce any difference in the musical notes whatsoever

Further experiments with Epsom salts disclosed, to my surprise and astonishment, the fact that there are in the market two kinds of Epsom salts, one which will emit musical notes during the solution and another will not. Whether there is a difference in the crystalline form of these salts I do not know. It reminded me of the story of Pasteur's work on the asymmetry which characterized [illegible]trates of many substances I have demonst[illegible] phenomenon before many physicians and [illegible] and none of them, they all assured me, ha[illegible]ced it before

Have I been the first man [illegible]se sounds? I dare not presume that this [illegible]phenomenon has never been observed before. I wonder, however, whether the research workers on the subject of "Solutions" have utilized this acoustic phenomenon in their work and whether there is any literature on this subject. The available literature in our public and medical libraries has no reference to this subject. If my observations are correct, then a new field for research is open for investigation.

C D SPIVAK

DENVER, COLO.

QUOTATIONS

THE MARCH TO HEALTH

THE decennial supplement of the *Registrar-General* contains a new national life-table for England and Wales This table is the work of the government actuary, Sir Alfred Watson, and is based on the figures of the population returned in the 1921 census and on the average number of deaths recorded in the three years 1920, 1921 and 1922 The new table confirms the opinion which is generally held, that "the vitality of the nation has been steadily improving" A rough measure of the improvement is afforded by a comparison of the "expectation of life" as indicated in the life-tables of 1906, 1911 and 1921 (the new table), respectively. In 1906 a male child at birth had an expectation of life of 48.53 years. In 1911 the expectation of life at birth had risen to 51.50 years The new table gives an expectation of life of 55 62 years. The figures relating to female children at birth are, respectively, 52 38, 55 35 and 59 58. It is pointed out in the report that improvement in the rate of mortality is specially marked at the youngest ages. The probability of a child's dying in the first year of life, for example, has decreased by about forty per cent. during the fifteen years between 1906 and 1921. Curiously enough an appreciable deterioration has occurred in the rate of mortality of women between the ages of eighteen and twenty-seven This deterioration, however, does not affect married women It may be that, in recent years, young women have been engaging in tasks which impose too great a strain upon their physical constitutions, in any case, it seems possible that woman's place in the industrial and commercial worlds can not be determined solely by woman's enthusiasm to enter and share these worlds. A further commentary on woman's strength as a worker and wage-earner may possibly be afforded by the fact that rates of mortality are invariably heavier among widows than among single women or wives The report deals at considerable length with mortality in different geographical areas of the country and confirms the prevailing view that the rate of mortality varies both with the geographical distribution of the people and with the density of the population But of these two the geographical is the preponderating influence. In all the areas examined the difference between the death-rate of county boroughs and that of rural districts is greater among males than among females, but the point is emphasized that this difference does not appear to be due to the greater strain of working conditions to which men are subjected, but to the relatively favorable mortality experience of the male population of rural areas The healthy conditions of country life, in other words, are enjoyed to a greater extent by men than by women, whereas in towns the two sexes are subjected, as a general rule, to the same kinds of conditions —*The London Times.*

SCIENTIFIC BOOKS

Fogs and Clouds. By WILLIAM J. HUMPHREYS. Baltimore, The Williams and Wilkins Company, 1926. 98 pp. of text, 93 illus.

OF the text, one may enthusiastically say that if laymen could avail themselves of the privilege of reading Dr Humphreys's lucid account of how these fogs and clouds come into and pass out of being, of the everchanging play of atmospheric processes that control their everchanging forms, a widespread intelligent interest in them might soon be expected. The book is in its author's best style. There is about

the descriptive matter often a deftness of touch which is altogether delightful. This is a "popular" work, but it suffers from none of those elements of vulgarization that too frequently creep into the "popular science" writing of this day. It is a book to be heartily commended to the teacher who strives for scrupulous accuracy in the non-mathematical presentation of scientific things

The publisher says on the jacket of the book that it contains "the largest and finest collection of cloud photographs ever presented in one volume" One must express surprise at this encomium. The illustrations are good, on the whole; some of them are very good; a scant few of them possess the almost stereoscopic loveliness in the halftone rendering of form and depth and distance, which is an outstanding characteristic of some recent foreign cloud books.

The clouds presented as types are in a few cases disappointing. It would be difficult indeed for all to agree on the choice of the picture intended to illustrate a given type. For instance, Figure 33, "Strato-cumulus, Roll Type," seems to the reviewer to present nothing more than a good cumulus cloudscape with the usual receding glimpses of the bases of ever more distant clouds. The well-formed cumuli in the nearer distance appear to indicate that conditions weren't right for roll-type cumuli just then. The strato-cumulus in Figure 34, on the other hand, could scarcely be finer. Figure 41, "Cumulus," pictures very prettily the grounds of the U S. Department of Agriculture in Washington. In Figure 42 the sky is quite too crowded with irregularly disposed cumulus bases to leave any just impression of the *en echelon* arrangement it was desired to portray.

Such comments relate after all, however, to failings which are not of major importance. One will have to go far to find a volume more serviceable to its purpose, or better adapted to making us familiar with the names and habits and vagaries of form of these transient visitors to our skies.

B. M. Varney

Department of Geography,
The University of California at Los Angeles

SPECIAL ARTICLES

THYROXIN AND COAT COLOR IN DILUTE RACES OF MICE AND RATS[1]

In the course of investigations of thyroid function, begun in 1921 on the domestic fowl, one of the most striking effects of experimental hyperthyroidism to be observed was the darkening of the plumage in such pigmented races as Rhode Island Reds, Barred Plymouth Rocks, Silver Campines and Brown Leghorns.[2] The addition of desiccated thyroid to the dietary of growing chicks, and the parenteral injection of thyroxin itself, led quickly to an increase both in quantity and extent of plumage melanins. This not only revealed a definite influence of the thyroid hormone on melanin production in these birds, but suggested a possible means of exploration by thyroxin of the pigment-forming mechanism itself, not only in birds but in mammals as well

Accordingly, experiments were begun on several color varieties of mice and rats Representatives of six varieties of mice, namely, piebald, pink-eyed, chocolate, dilute chocolate, dilute black and albino, and one variety of rat, namely, dilute black-hooded, received systematic abdominal injections of thyroxin. The dose for all ages was approximately 1 mgm. of thyroxin to every 500 grams of body weight, administered at intervals of three or four days. Interest centered chiefly about the behavior of naked or nearly naked [illegible] which thyroxin could be given as the coat [illegible] from birth onward. When adults were [illegible]roxin, a patch of hair was clipped fro[illegible]n each case.

In sharp c[illegible] the response of the domestic fowl, the adm[illegible] of thyroxin under the conditions of the experiments produced no effect whatever on the coat color of the rats and mice, young and old. The facts will be sufficiently established by a brief review of four typical experiments.

1. To 5 dilute chocolates, 2 dilute blacks, and 6 piebalds, all well grown, thyroxin was administered as follows:

June 28	.03 mgm. each			
30	.03	"	"	
July 2	.03	"	"	
5	04	"	"	Hair clipped from area on rump
9	04	"	"	
14	.05	"	"	
16	05	"	"	
19	.05	"	"	
21	.05	"	"	
23	05	"	"	
26	.05	"	"	
28	.05	"	"	
30	05	"	"	
2	.05	"	"	
6	.06	"	"	
9	.10	"	"	Injections discontinued.

In none of these animals, either during the period

[1] This inquiry was aided by a grant from the Carnegie Institution of Washington. The stock used was obtained through the kindness of Dr. W. E. Castle and Dr. M. R Curtis.

[2] Anat. Rec., xxiv, 395; Proc. Soc. Exp. Biol. Med., xxiii, 536; Biol. Bull., in press.

of the injections or for six months thereafter, were any changes noted in the coat color that could be attributed to thyroxin.

2. To 1 albino and 5 chocolate mice, forming one litter from a chocolate mother and weighing about 3 gms. each, thyroxin was administered as follows:

June 24	.005 mgm each	
28	.006 " "	
30	.006 " "	
July 2	.012 " "	
5	.016 " "	Hair clipped from rump area.
9	.020 " "	
10	.024 " "	
14	.030 " "	
16	.030 " "	
19	.030 " "	
21	.030 " "	
23	.030 " "	1 chocolate died.
26	.036 " "	1 chocolate died.
28	.036 " "	1 chocolate died
30	.036 " "	
Aug. 2	.040 " "	
6	.050 " "	
9	.060 " "	[illegible] discontinued

As in the case of the ad[illegible]sidered, thyroxin produced no apparen[illegible] coat color of either chocolate or albino d[illegible] after the series of injections.

3. To 5 dilute black-hooded rats, of the same litter, weighing about 15 gms. each, with eyes unopened, hooded pattern visible, hair very short except for a few long hairs, thyroxin was given as follows:

April 24	.05 mgm. each	
30	.05 " "	Hair well out. Pattern marked.
May 6	.05 " "	
12	.05 " "	
7	.05 " "	Injections discontinued

Results as in the preceding cases.

4. To 5 dilute black-hooded rats, weighing about 6 gms. each, and naked, thyroxin was given as follows:

June 24	.008 mgm. each	
28	.010 " "	
30	.010 " "	
July 2	.014 " "	2 dead
5	.018 " "	1 dead
9	.024 " "	
10	.026 " "	
14	.034 " "	
16	.040 " "	
19	.040 " "	
21	.044 " "	
23	.050 " "	
26	.050 " "	
28	.050 " "	
30	.050 " "	Injections discontinued.

Results as in preceding cases.

This failure of the mice and rats to respond to thyroxin indicates a marked difference between the mechanisms involved in feather and hair pigmentation in the birds and mammals observed. Large amoebid melanophores play a peculiar and conspicuous rôle in the development and distribution of feather melanin, a process that appears to have no counterpart in the developing hair. It is unlikely, however, that this or any other such histological difference is of fundamental importance in this connection. The simplest assumption to account for the observed facts is that these unresponsive varieties do not possess the factors essential, with or without thyroxin, to a deepening of their coat color beyond its typical limit. Dilute chocolate and dilute black do not appear merely as less intense color varieties of chocolate and black respectively, but differ from the latter in the absence of factor or factors necessary to the production of their characteristic coloring. The result of the physiological test with thyroxin thus accords with the well-known facts of their genetic behavior and current conceptions of their genetic constitution.

Harry Beal Torrey

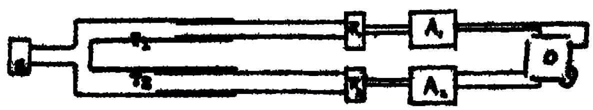
ON THE VELOCITY OF SOUND

The velocity of sound as a function of tube diameter has received consideration from time to time. Helmholtz, in 1863, proposed, without demonstration, the following as the governing relative,

$$V = V_0\left(1 - \frac{c}{d\sqrt{n}}\right)$$

where V_0 is the velocity in free air at 0° C., d is the diameter of the tube, n the frequency and c a constant. Later Rayleigh derived this relation from certain dynamical considerations but the experimental support for it has been meager and not satisfactory, due to lack of sufficient accuracy in velocity measurements.

Some years ago, Wold carried out some measurements by a method illustrated in the figure. Sound-waves from a tuning-fork or diaphragm at S travel down tubes T_1 and T_2 of variable length. The waves



are picked up by receivers R_1 and R_2 of the condenser transmitter type. The outputs are amplified by six stage amplifiers A_1 and A_2 and impressed on

the orthogonal pairs of plates of a low voltage Braun oscillograph tube. The Lissajous figure resulting can be brought to a straight line by adjustment of one of the tubes. If now one tube is gradually changed in length through one wave-length, the figure will pass through its elliptical cycle back to a straight line This method of finding wave-length has shown itself capable of a surprisingly high degree of accuracy

Recently, we have repeated the work with refinements as to frequency and temperature control and corrections for humidity The attempt has been made to reach an accuracy of one part in ten thousand, but this has not been attained as yet, probably due to the effects of reflected components of the waves within the system These have been greatly reduced but not entirely eliminated The results thus far obtained, using brass tubing, seem to confirm Helmholtz's relation and are best represented by the following

$$V = 331.4\left(1 - \frac{4.45}{d\sqrt{n}}\right)\frac{\text{meters}}{\text{sec}}$$

P. I. Wold,
Geo R Stibitz

Union College,
Schenectady, New York

WATER TRANSLOCATION IN YOUNG FRUITS[1]

Immature succulent fruits are essentially masses of meristematic tissue, although most of the protoplasts contain well-defined vacuoles. Their cells are everywhere in contact with neighboring cells, without interruptions by intercellular spaces Almost universally these cell walls contain pectic (or related) substances which possess marked imbibitory properties The purpose of this note is to emphasize a consequence of these conditions which is generally overlooked, namely, the importance of these hydrophilic layers in the translocation of water through the tissues. Our observations make it apparent that imbibed liquid passes over the surfaces of these cells, as well as through them by osmosis The fibrovascular bundles furnish channels by which water and dissolved substances may enter the fruit, but the majority of the cells are at some distance from the ultimate divisions of the bundles. Liquids such as those found in young fruits will not readily diffuse through protoplasts, but they will pass through the pectose layers by imbibition.[2]

The tissues of the young fruits which we have examined are composed of parenchyma cells without intercellular spaces. Unchanged cellulose is found in the walls of these cells, especially in the peripheral regions, though in the deeper lying layers the cell walls frequently do not show the cellulose reaction. When sections of fresh material are treated with ruthenium oxychloride solution the cell walls become deep pink, thereby giving evidence of pectose. The reaction is particularly strong in sections of the mesocarp of lemons, the endocarp of walnuts, the exocarp of apples, and the pericarp of tomatoes and of *Carissa grandiflora* The thick walls of these cells may be readily seen in sections of fresh material if a proper mounting solution is used, but it is necessary to use a liquid which does not mix with water We have used xylol. If the sections are in contact with an excess of water the colloidal layers swell to such an extent that their boundaries are indistinct If they are mounted in 95 per cent. alcohol the water may be so completely removed from the colloidal layers that the[illegible]hickness is not seen.

The rate of [illegible]vement in these fruits seems fairly rapid[3] [illegible]ctuations in size are in large measure dep[illegible] the amount of water held by the colloid[illegible] the fruit. The distribution of water betwe[illegible]protoplast and its bounding wall doubtless is an expression of the equilibrium between the imbibitional power of the wall and the osmotic attraction exerted by the contents of the protoplast When cell walls of wilted and turgid fruits are examined in xylol those of the wilted fruits show a marked decrease in thickness.

It is well known that the tissues of these and other immature fruits are rich enough in pectose to be valuable for the preparation of jellies and jams, but we wish to call attention to the occurrence of these hydrophilic layers in the cell walls, and to emphasize their importance as paths for the translocation of water.

H. S. Reed
E. T. Bartholomew

University of California

[1] Paper No. 170 University of California, Graduate School of Tropical Agriculture and Citrus Experiment Station, Riverside, California.

[2] Tupper Carey, R. M, and J. H. Priestley. "The Composition of the Cell Wall at the Apical Meristem of Stem and Root." Proc. Roy. Soc. London B. 95: 109–131. 1923.

[3] Bartholomew, E. T "Internal Decline of Lemons. III. Water Deficit in Lemon Fruits Caused by Excessive Leaf Evaporation." *Amer. Jour. Bot.* 13: 102–117. 1926.

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ERWIN F. SMITH

DR. ERWIN F. SMITH, scientist of the United States Department of Agriculture, whose death occurred on April 6, was one of the chosen few who are given to do great things The continuous emanation of outstanding contributions to useful knowledge from his laboratories testified, not only to the fruitfulness of his individual efforts, but was significant also of his ability to stimulate and draw out the best talent of the group of unselfish workers with whom he was associated Considering the modern trend toward individualism in scientific work, this was a mark of high distinction and an outstanding characteristic of the man. One was always impressed by the tone of quiet and unassuming energy and efficiency which prevailed among his devoted coworkers in the laboratory of plant pathology The guiding hand of real genius was evident in every detail of the multitude of activities carried on there, touching as they did upon all phases of the science which he had advanced more than any other man.

Dr. Smith was almost an ideal representative of that type of inspired scientist who could suppress all desire for worldly advancement in order to devote all of his physical resources and his splendid intellectual equipment to the attainment of scientific truth. His home life as judged by the luxurious standards of modern conduct was almost ascetic in its simplicity, his books, the tools of his trade and the other accessories of scientific research being the only items of considerable expense which he never denied himself. He spared no outlay for these things and surrounded himself with them to have at hand the necessities for uninterrupted study during what would ordinarily be the hours of leisure. An interesting commentary on Dr Smith's evaluation of the requirements for the type of life he led is found in the fact that his modest home was illuminated in the style of the past generation and that in this day of universal transportation on rubber tires he preferred to walk. Only during the last few weeks of his life, when he must have felt his physical powers waning and undoubtedly had a premonition that conservation of his strength was essential, did he make use of taxicabs to convey him to and from the laboratory.

This unusual man never allowed himself to be drawn into the purely social functions which only too often are the tribute levied by the idle upon the time of the workers of the world. He knew the necessity

for conserving his energy for the great work to which he had dedicated his life and his daily routine of working, eating and sleeping was planned with the utmost care to permit a concentration of his magnificent mental equipment upon the daily attack on his research problems. Some fifteen years before his death, Dr Smith discovered that two sparing meals per day were sufficient to sustain him at the maximum efficiency and he rigidly adhered to this practice until the end While his abstemiousness was not forced upon the attention of others, it is noteworthy that he never used tobacco or intoxicants. An almost perfectly ordered life enabled him to carry on with increasing effectiveness far beyond the time when most Americans are forced to submit to the inevitable penalty for too strenuous and ill-planned application to their tasks

The personal appearance of Dr Smith, especially his face with full white beard, was striking. His countenance was easily recognizable as that of a scholar, full of reflective force and studious determination. The expression of benign good humor which generally characterized him was fully justified by a helpful, kindly disposition. Especially was he unfailing in extending help and advice with patient courtesy to students who sought his laboratory to take advantage of the opportunity for improvement in their methods and point of view by contact with one of the greatest exponents of the young science of plant pathology No one who was able to convince Dr. Smith of his sincere interest and intelligent grasp of his problems was ever denied full and complete liberty to study the methods of work in the laboratory where standards of technique in plant pathological investigations were so largely developed. Foreign students, of whom an unending stream came from Europe and Japan to the laboratory of plant pathology, some of them for prolonged visits, were assured of a hearty welcome and courteous treatment during their sojourns. Evidence of the generosity of his spirit is not confined to extending aid and stimulation to scientists in these purely intellectual associations, but many times he rendered assistance of a more substantial sort when the need arose.

His scientific attainments, which are well known to the world, open up the almost inexhaustible topic of Dr Smith's traits of character Early in life he had shown great determination in wringing an education from an unsympathetic world in the face of discouraging obstacles It was necessary for him to find employment to earn means for attending both high school and college, and he did not graduate from the University of Michigan until he was thirty-two years of age. The quality of persistence despite handicaps, however great, enabled him to complete difficult assignments with marked success after he was appointed to the Department of Agriculture in 1886, the year of his graduation. A masterful experimentalist and an indefatigable worker, his early work in the department soon attracted attention. All his researches, brilliantly conceived and executed, were marked by a thoroughness that left no room for disagreement with his results. He soon established a reputation for complete accomplishment and very rarely were his researches marred by premature or conjectural conclusions. Vague conceptions and baseless speculations that so often obscure explorations of the unknown are not to be found in his clear-cut contributions. Notwithstanding, he found himself at times confronted with hostile skepticism, notably the antagonism of the distinguished German scientist, Alfred Fischer, who maintained purely on *a priori* grounds that the tissues of growing plants were an environment unsuited to the growth and development of bacterial organisms. By his complete and convincing refutation of this viewpoint, Dr. Smith extended his reputation beyond the limits of the United States and became the acknowledged international leader in the field of bacterial diseases of plants. In his later years, after his work on crowngall had led him to note the remarkable analogy between plant and animal overgrowths, it was evident that he was eager to pursue to an ultimate conclusion the question of possible bacterial causation in connection with one of the world's greatest unsolved problems, that of human cancer. In advancing this work he attracted the attention of medical experimentalists and stimulated research that may serve to finally elucidate the origin of this dreaded disease. Consistent with his usual caution in not accepting results unless adequately repeated and with the most rigid scrutiny of methods, he was intensely interested but not carried away when it was announced late in 1925 from Dr Blumenthal's laboratory in Berlin that an organism isolated from human breast cancer had produced tumors when inoculated into plants and rats. The possible identity of the organism causing plant and animal tumors was apparently never in his mind, but the remarkable similarity in ontogeny and structure of the various types of overgrowths in the plant and animal kingdoms convinced him that the animal tumor, as he had proved with the analogous plant tumor, is originated by infection with a parasitic organism. In common with all of his scientific endeavors this work typifies his zeal in the service of mankind, the conservation of food crops or the alleviation of human suffering having been always uppermost in his thoughts and in fact to him was the principal justification for his existence. Whatever may be the outcome of his venture into the field of animal pathology, his place in the annals of the science of

plant pathology which he helped to elevate to a profession of high standing will endure for all time In this line of endeavor nature's obedient response to his interrogations is well evidenced by a survey of the astonishing number of publications he has contributed, 167 original and 73 reviews, a total of 240.

It is not necessary to say to the friends of Dr. Smith that his culture was far more than plant pathological An inherent love of the more refined embellishments of our civilization, especially literature, served to further distinguish this many-sided man. A patron of all the arts, he was a master of lucid composition and a gifted poet. A book of verse published privately in 1915, containing 197 sonnets and other original poems, together with understanding and sympathetic Latin translations from the German, French and Italian languages, is an achievement of his creative ability, practically unknown except to the small circle of friends among whom the limited edition was circulated. His fondness for the beautiful city of his adoption was not confined to a detached admiration of its charm. As a member of the Arts Club of Washington he actively served with the enthusiastic and disinterested groups of public-spirited citizens in movements designed for preserving its natural beauty and enhancing it with architectural adornments in keeping with the vision of L'Enfant.

A glimpse into his home disclosed a veritable treasure house of art objects and a superlative library selected with discriminating taste during a long lifetime of profound meditation on the serious things of this life and the hereafter. Dr Smith was not a churchman in the sense of regular display of piety, but he was deeply religious and his faith as revealed in his written records constitutes an answer to the challenge of the fundamentalists who see in the interpretations of science an undermining of the structure of Christianity

At a time when he could look back over the course of a long life rich in service to his fellowmen and just following the spontaneous tribute to his genius by his fellow scientists at the Philadelphia meetings of the American Association for the Advancement of Science he passed into the state which can not be voiced more fittingly than in his own words.

QUIETUDE: A PRAYER

God of all flesh, when these my days are sped
Let me but hear the music of the spheres
Or see, far off, the progress of the years
And I shall be greatwhile content though dead;
For to their heavenly music I am wed
And thrill with subtile thrills, nor yield to fears.
Thy great To-morrow wipes away all tears
And there, as here, Thy law shall be our bread.
Then let me dwell in some great quiet place
Where I may brood in peace on time's deep things
And all the mystery that round man clings;
Far off, mayhap, have glimpse of one sweet face;
And catch the tones of twanging golden strings
Whereto Thy myriad million stars keep pace!

E. W. BRANDES

UNITED STATES DEPARTMENT
OF AGRICULTURE

COLLEGE LIBRARIES AND CHEMICAL EDUCATION

WHETHER we would have it or no, the purpose of the small college is changing. A decade ago the graduate of a college was thought to be fitted with the requisites of a cultural, liberal education, to be ready to begin his life work as a good citizen. Within a generation, however, has come an era of specialization Everywhere we see the demand for the expert worker, the professional man who has devoted from two to four additional years to train himself in a special way in a particular field

The small college has stood staunch in its desire to supply the liberal education and perhaps it has done well in maintaining this position On the other hand, many of the large universities have shifted the emphasis from undergraduate work to graduate study. Still others have tried to develop both side by side. Few of the small colleges have kept astride with the inevitable consequences of such a situation. The few who have are sending an increasing number of their graduates to these universities to complete their training. As an example of this, it is the boast of Pomona College that over seventy per cent of her graduates have taken subsequent professional training. It has become the evident duty, therefore, of the small college to prepare its men, not only to enter such graduate schools, but also to meet successfully the ever-increasing intensity of competition found there. This in addition to supplying a broad cultural education This duty has brought with it a number of problems of first magnitude. One of the biggest of these is the problem of adequate library facilities

It is the purpose of this paper to discuss this problem with special reference to the student whose college major is chemistry. The answer to the question of what books a library in chemistry should contain will be found excellently answered in a book, containing a list of 1,600 books, each one judged by experts as to importance and value. This book, edited by Patterson and Crane, will soon be available. The problem of the purchase of new books as they appear is one which must be answered anew for each

volume and can hardly be discussed in a paper of this kind. Fortunately, perhaps, the question of books is a minor part of the principal problem, and is almost totally eclipsed by the bigger question: What files of scientific periodicals are needed in a college library successfully to prepare the student for advanced work, taking into consideration also those materials necessary for the stimulation and intellectual development of the faculty? This latter need is quite as important as the first because of the increasing demand of the colleges for instructors with the doctorate degree Such men are reluctant to accept positions in colleges where facilities for continuing the research which they have learned to love are lacking

One way to answer this question would be merely to sit down and compile a list of those journals which one considers indispensable Such a procedure might prove eminently successful in certain cases, but it seems reasonably certain that often the result would be seasoned too much by the needs, likes and dislikes of the compiler. In casting around for a better method of arriving at the answer, the writers decided to seek an arbitrary standard of some kind by which to measure the desirability of purchasing a particular journal.

If one grants, to avoid argument, that the department is trying to train men, first, to understand the science of chemistry (including, of course, the methods and means of advancing the frontiers of the science) and, second, to be able actually to contribute to this progress, then it seems inquiry should be made into the library tools which men are using who are now doing just this. With this purpose in mind, it was decided to tabulate the references in a single volume of *The Journal of the American Chemical Society* This journal was chosen as the most representative of American chemistry. It is believed that the results of such a tabulation can be considered statistically and used with certain reservations to predict the future needs for a period, let us say, of ten years The most recent complete volume (1926) of this journal has been chosen and the results tabulated in such a way that the relative importance of any single periodical for any five-year period can be seen. This is very important when one considers that only relatively few libraries can afford complete files of journals which have been published continuously for a century or more.

TABLE I

	Total	1921–1925	1916–1920	1911–1915	1906–1910	1901–1905	1896–1900	1891–1895	1886–1890	1881–1885	1876–1880	1871–1875
Ber	686	78	30	67	115	79	64	60	56	53	44	33
J. Chem. Soc.	390	122	37	60	45	47	21	20	5	2	1	—
Ann.	278	26	8	37	33	23	22	21	19	13	13	—
Z physik Chem.	191	53	6	21	29	19	28	16	6	—	—	—
Compt rend	126	26	3	23	15	23	15	21	7	9	8	—
J Phys. Chem.	93	42	13	13	5	1	1	—		—	—	—
Ann Physik	93	18	4	28	13	6	0	0	6	5	2	—
J Biol. Chem	80	41	16	14	7	—	—	—	—	—	—	—
Am. Chem. J.	70		—	9	21	20	14	8	4	2	1	—
Z anorg Chem	68	21	11	5	8	11	6	2	—	—	—	—
Ann. Chim	68	5	0	6	9	7	3	5	1	8	4	2
Bull Soc. Chim	60	16	3	4	7	10	4	4	3	4	2	1
Proc. Roy. Soc	55	30	5	4	8	5	1	0	1	—	—	—
J Ind. Eng Chem	53	33	10	5	1	—	—	—	—	—	—	—
Z. Phys.	51	41	5	—	—	—	—	—	—	—	—	—
Monatsch	51	2	1	21	5	9	3	2	5	3	—	—
J prakt Chem	50	6	1	2	2	6	3	12	6	6	2	2
Phil Mag	49	17	14	4	2	3	3	1	1	0	0	1
Gazz chim. ital	44	10	6	2	6	4	8	4	8	0	1	—
Phys. Rev	44	28	8	3	5	4	—	—	—	—	—	—
Physik Zeit	41	26	0	7	8	—	—	—	—	—	—	—
Z Elektrochem.	37	11	13	4	4	4	1	—	—	—	—	—
Biochem. Z	37	18	2	9	10	—	—	—	—	—	—	—
Rec. trav. chim.	36	14	5	2	2	2	5	4	1	1	—	—
SCIENCE	27	22	3	—	—	—	—	—	—	—	—	—
Trans Far Soc	24	18	0	1	0	1	—	—	—	—	—	—
Proc. Nat'l Acad.	22	19	0	—	—	—	—	—	—	—	—	—
Nature	21	13	5	1	—	—	—	—	—	—	—	—

The abbreviations used above and in the tables to follow are those accepted by *Chemical Abstracts* and may be found in their list of periodicals abstracted, issued October 20, 1926.

For the purposes of this tabulation, references to *The Journal of the American Chemical Society* have been excluded. References to the current year (1926) are not included in the tables except in the totals because of the fact that certain journals published near at hand are more readily available than others and references to the current year would, of course, be more numerous for these journals than for others. The total number of references thus considered was found to be 3,633 and these were found to be distributed among 247 different journals or periodicals. In Table I are given the results of this tabulation for the leading 28 periodicals, arranged in order of total number of references. A short study of this table will show that a large total number of references is not the only criterion of desirability which should be applied. It must be realized that a periodical which has been in existence for only ten years, having, let us say, but half as many references as one which has been published continuously for fifty years, would be more desirable, dollar for dollar invested, than the latter, assuming the cost per year to be comparable in the two cases. It is also possible that a journal may have been of such quality for a long period of years that it is now little used and that in later years its quality may have improved or the nature of its material changed in such a way that it is now a very valuable journal. The reverse change is even easier to imagine. It is for such reasons that the distribution as to years of publication of articles referred to is given after the column giving the total number of references.

The distribution of references not included in the above table is shown in Table II.

TABLE II

Number of references	Number of periodicals
15–20	7
10–14	15
5– 9	27
3– 4	37
2	33
1	99

The meaning of Table II is made clear when it is stated that there were 99 periodicals to which there was but a single reference, or that there were 27 journals to which reference was made from five to nine times each.

A third tabulation will prove valuable in deciding the [illegible] journals should be included in the current li- [illegible] lists, even though funds may not be available for the extensive purchase of back-files. In this connection, it must be realized that the "present trend" rather than the "past performance" of a journal should be considered first. In Table III the journals have been rearranged in order of number of references in the period 1916–1925 inclusive.

TABLE III

Name of Journal	No. of references 1916–1925
J. Chem. Soc.	159
Berichte	108
Z. Phys. Chem.	59
J. Biol. Chem.	57
J. Phys. Chem.	55
Z. für Physik	46
J. Ind. Eng. Chem.	43
Proc. Roy. Soc.	35
Annalen der Chemie	34
Z. anorg. Chem.	33
Ann. Physik	32
Phil. Mag.	31
Phys. Rev.	31
Compt. rend.	29
Phys. Zeit.	26
SCIENCE	25
Z. Elektrochem.	24
Biochem. Z.	20
Proc. Nat. Acad. Sci.	19
Rec. trav. chim.	19
Bull. soc. chim.	19
Trans. Far. Soc.	18

The importance of such a tabulation is realized when the relative positions of periodicals are compared in Tables I and III. For example in Table I, Liebig's *Annalen der Chemie* is third while *Zeitschrift für Physik* is in fifteenth place, while in Table III *Annalen* is ninth and the *Zeitschrift fur Physik* is in sixth place. It must apparent that to the American chemist the current number of the latter journal is of more importance than a current number of the classical *Annalen der Chemie*.

The use of these tables is left to the individual reader who will know best how to adapt them to a local need. The following conclusions formulated from them by the writers may prove of assistance in making such applications.

(1) It is assumed that the first need of any American college chemistry library is a complete file of the publications of The American Chemical Society: *The Journal of the American Chemical Society, Chemical Abstracts, The Journal of Industrial and Engineering Chemistry.*

(2) The complete file of the *Berichte der deutschen chemischen Gesellschaft* is indispensable. It must

come as a surprise to many chemists, even though they were conscious of the vast number of references to this journal, that 18.88 per cent., or almost one in five, of all references are to this single journal.

(3) The file of *The Journal of the Chemical Society* (London) should begin with 1891 and be complete to date Even though funds for back-files are not available, this journal should be included in the current subscription lists of every library. This will be realized if reference is made to Table III

(4) The file of the *Zeitschrift fur physikalische Chemie* should be complete from 1895 to date, and it should be on the current subscription lists. From its present trend of usefulness (*vide* Table III) it is believed that this journal deserves consideration before *Liebig's Annalen der Chemie* There is another reason for placing this journal next, because by so doing the balance between organic and physical chemistry is better maintained

(5) Next in importance, perhaps, is *Annalen der Chemie* (Liebig's) It should be borne in mind that many of the classical researches to which students studying organic chemistry should be constantly referred are found in the back files of this journal. The quality and usefulness of this journal has apparently been very uniform since its first publication Because of this fact, the back files should begin as far back as possible. Original reprint of this journal is now almost impossible to obtain. Anastatic reprint is available, however, at not unreasonable cost It should be remembered that such reprint when reproduced from old and time-worn original print may not be first class.

(6) Certainly no American college library of chemistry should be without *The Journal of Physical Chemistry* to-day Apparently the quality of this periodical has been much improved recently. (See Table I) Back files should certainly start as early as 1920 and wherever possible with 1910 issues.

(7) Next in importance, the writers place *The Journal of Biological Chemistry*. This journal should only be considered by colleges where members of the staff in chemistry or biology are interested in this field Students looking forward to the study of medicine should be provided with this journal. Back files might well begin in 1920

(8) Attention should be called to the recently growing importance of so-called "practical" journals for academic work. Publication of research has been at such a pace that the regular channels of publication are overcrowded The natural result of this is that many articles of academic interest are now being regularly published in non-academic journals. An excellent example of this is found in the marked increase in usefulness, as exemplified by the number of references to it, of *The Journal of Industrial and Engineering Chemistry*. (See Table I, 1921–25.)

(9) An interesting and important corollary of this tabulation is discovered when one considers the language of publication of the references tabulated. Considering only the foreign periodicals (*i.e.*, excluding those published in the United States) the results are found in Table IV.

TABLE IV

Language	Number of references	Per cent.
German	1667	52 5
English	1119	35.2
French	300	9.4
All others	87	2 8

Certainly it should be insisted that a reading knowledge of German be required of every student majoring in chemistry in college French can hardly be accepted as a substitute although it should, of course, be urged as a complementary tool of value.

(10) The conclusions which precede have been drawn from a consideration of periodicals which are strictly chemical in their subject matter. Due to the rise of physical chemistry during the last decade, there are an increasing number of journals usually considered in the domain of physics which must be considered as important for a chemistry student. This fact must not be lost sight of in the expenditure of library funds. The following journals which come in this class are of prime importance to the chemist and might well be considered jointly by the departments of physics and chemistry: *Annalen der Physik, Zeitschrift für Physik, Physical Review, Physikalische Zeitschrift* and *Transactions of the Faraday Society*.

(11) There is also a group of periodicals of even wider interest than the group immediately preceding. These might well be considered by the entire science division of the college faculty, as material of interest in astronomy, biology, chemistry, geology, mathematics, physics, etc., is included. The list follows: *Philosophical Magazine, Comptes rendus de l'academie des Sciences*, SCIENCE, *Nature, Proceedings of the National Academy of Sciences* and *Proceedings of the Royal Society* (London).

Perhaps the writers have not succeeded in answering the general question which they set for themselves at the outset of this survey. Perhaps, however, they have succeeded in pointing the way in which this question may be more readily answered [illegible] may

chemists, who may profit by the data here tabulated. Perhaps, also, the way has been pointed for workers in fields other than chemistry to answer this question for themselves. If this partial success has been achieved, the time and labor expended in this study will have been amply repaid.

P. L. K. Gross
E. M. Gross

Department of Chemistry,
Pomona College

SCIENTIFIC EVENTS

ZOOLOGY AT THE NASHVILLE MEETING OF THE AMERICAN ASSOCIATION

The American Society of Zoologists and section F (zoology) of the American Association for the Advancement of Science will hold joint sessions for the reading of papers at Nashville from Wednesday, December 28, to Friday, December 30, inclusive The Hermitage Hotel, Sixth Avenue and Union Street, will be headquarters for members of both organizations, the stated price for single rooms is $2.50 to $5.00 Those planning to attend the meetings are strongly advised to write direct to the hotel and make reservations as early as possible, since it may not be possible to accommodate all.

On Wednesday evening will be held a biologists' smoker; on Thursday evening the zoologists' dinner, and on Friday evening the naturalists' dinner, all in the Hermitage Hotel At the zoologists' dinner, Thursday evening, Professor W C. Curtis, retiring vice-president of section F, will deliver his address on the topic, "Old Problems and New Technique" Sessions for the reading of papers will be held in the school of medicine, with ample provision for meetings and for demonstrations.

Members of section F, not members of the American Society of Zoologists, who desire to read papers, should submit titles accompanied by abstracts not exceeding 250 words. These may be sent to the secretary of section F at the address subscribed to this notice any time before November 12, or they may be sent direct to the secretary of the American Society of Zoologists, D. E. Minnich, department of zoology, University of Minnesota, any time before November 15. Papers will not be received by the secretaries after these respective dates. The maximum time allowed for the presentation of a paper is fifteen minutes. The American Society of Zoologists has charge of the program and arrangements.

General announcements regarding the matters of transportation, housing and the like, will be found in the preliminary statement of the permanent secretary of the American Association for the Advancement of Science, soon to be published.

Geo. T Hargitt,
Secretary, Section F

Lyman Hall, Syracuse University,
Syracuse, N. Y

THE INTERNATIONAL OFFICE OF CHEMISTRY AT PARIS

The American Chemical Society has addressed a letter to the Secretary of State, Frank B. Kellogg, stating its opposition to American membership in the International Office of Chemistry at Paris, to which an invitation to membership has been received from the French government.

The letter to Secretary Kellogg, made public by the secretary of the society, Charles L. Parsons, states that the invitation of the French government is still before the department for consideration The Department of State, however, in commenting upon the letter October 18, stated that the invitation of the French government was received on June 1, 1926, and that a reply had been sent August 12, 1926, that the "United States Government had reached the opinion that the compensatory advantages that would accrue to it through membership in the International Office of Chemistry were not sufficient to warrant the United States Government in becoming a member of the office at this time"

The full text of Dr Parsons' letter follows:

Hon Frank B. Kellogg,
The Secretary of State,
Washington, D C

Sir By vote of the council of the American Chemical Society, I was requested to call your attention officially to the enclosed October 10 issue of the News Edition of the official organ of our society

The American Chemical Society has in its organization practically all of the prominent and influential chemists of America and a membership of approximately 15,400.

We would respectfully request that, before any action is taken by the United States toward participating in the International Office of Chemistry which is still before your department on proposal of the French Republic, careful consideration be given the facts and data presented in this publication.

The American Chemical Society is very strongly opposed to the creation of any international center for the control of chemistry, whether it be located in France or elsewhere. We would, accordingly, request that this communication and this publication be duly filed with the proposals which have been received from the French Government covering the International Food Laboratory and an International Office of Chemistry

LECTURES AT THE FIELD MUSEUM OF NATURAL HISTORY

A SECOND series of ten free lectures on science and travel, illustrated with moving pictures and stereopticon slides, to be given at Field Museum of Natural History this autumn and winter, has been announced by D C Davies, director of the museum. All lectures will be given in the James Simpson Theater of the museum, and begin at 3 P M, and are open to the general public

Following are the dates, subjects and lecturers for the new series

Nov 6.—*The depths of the sea* Dr Raymond L. Ditmars, curator, New York Zoological Park

Nov. 13—*The Captain Marshall Field Brazilian expedition of 1926.* George K Cherrie, leader of the expedition

Nov 20—*Abyssinia.* (The Field Museum-Chicago Daily News expedition to Abyssinia) Dr Wilfred H. Osgood, curator of zoology, leader of the expedition

Dec. 4.—*Beneath tropic seas* Dr William Beebe, director of tropical research, New York Zoological Society

Dec 11—*Adventures, archeological and otherwise, in Arabia, Egypt, the Sudan, Sinai, Transjordania, Palestine and Syria* Lowell Thomas, author and traveler

Jan. 14—*Birds and animals of Alaska.* William K Finley, director of wild life conservation, State of Oregon

Jan 15—Same lecture as Jan 14

Jan. 22.—*The way of the sperm whaler* Dr. Robert Cushman Murphy, American Museum of Natural History

Jan. 28.—*Explorations in plant life* Arthur C Pillsbury

Jan 29—*The Malay Peninsula* Carveth Wells.

The general public is invited to these lectures Members of Field Museum may reserve seats for themselves

The five Saturday lectures of the first series remaining to be given are as follows

Nov 5—*The depths of the sea* Dr Raymond L. Ditmars, New York Zoological Park

Nov 12—*The Captain Marshall Field Brazilian expedition of 1926* George K. Cherrie, leader of the expedition

Nov 19—*Explorations at the North Pole of the winds* Professor William H Hobbs, leader, University of Michigan Greenland Expedition

Nov 26—*Sun dance of the Blackfoot Indians* Walter McClintock, Pittsburgh

Dec 3—*The wonders of marine life* Dr William Beebe, New York Zoological Society

DEDICATION OF THE NEW MEDICAL LABORATORIES AT THE UNIVERSITY OF CHICAGO

FORMAL opening of the university clinics and new medical laboratories at the University of Chicago will take place on October 31 and November 1. On these dates special convocation and dedicatory exercises will be held, which will include the following clinics and addresses

Medicine and the university: JAMES ROWLAND ANGELL, president of Yale University

Reduction of dyes by biological systems and some remarks on the mechanism W MANSFIELD CLARK, professor of physiological chemistry, the John Hopkins Medical School

The regulation of respiration ROBERT GESELL, professor of physiology, the University of Michigan

Studies in drug tolerance, with special reference to the esters of nitrous and nitric acids ARTHUR S LOEVENHART, professor of pharmacology, the University of Wisconsin

Some recent investigations on antigens KARL LANDSTEINER, member of the Rockefeller Institute for Medical Research

Medicine and science · ALFRED E COHN, member of the Rockefeller Institute for Medical Research.

Urea excretion in nephritis DONALD D VAN SLYKE, member of the Rockefeller Institute for Medical Research

Clinical demonstrations. ARTHUR DEAN BEVAN, professor of surgery, Rush Medical College of the University of Chicago

The non-excretory functions of the kidney · I SNAPPER, professor of pharmacology and general pathology, the University of Amsterdam

The present status of cancer research · FRANCIS CARTER WOOD, director of the Institute of Cancer Research, Columbia University.

The hospital and the laboratory RUFUS COLE, director of the hospital of the Rockefeller Institute for Medical Research

Bacterial endocarditis · WILLIAM S THAYER, professor emeritus of medicine, the Johns Hopkins Medical School

Diseases of the gall bladder EVARTS AMBROSE GRAHAM, professor of surgery, Washington University School of Medicine

In the group of five buildings, one for physiology, pharmacology and physiological chemistry, one for pathology, one for the medical clinic and one for the surgical clinic, there is an administration building in which are placed many services that will be used in common Near by are the laboratories for the premedical sciences and for the underlying sciences in medicine that are not included in the new medical group

Hospital and out-clinic service is now available at the university in general medicine, surgery, eye, nose and throat and neurology. The new building on the Midway of the Chicago Lying-In Hospital, affiliated with the university, will provide for obstetric cases at a later date The Charles Gilman Smith Memorial Hospital, to be built soon, will care for contagious diseases; the Bobs Roberts Memorial Hospital, for children; and the Gertrude Dunn Hicks Memorial, for

orthopedic surgery. The Chicago Lying-in Hospital is now engaged in raising the last $400,000 of the $1,000,000 required for its funds, and gifts have already provided for the construction of the other hospitals.

The service of the University of Chicago clinics is available to all classes of patients, with special provision for persons of restricted means in both the outpatient department and the hospital The clinics contain 6,660,600 cubic feet of space—one third of the total of all university buildings The medical school of the university now represents an investment of twenty million dollars, seven millions in the buildings and thirteen millions in endowments

THE BUREAU OF ENTOMOLOGY AND DR. L. O HOWARD

AFTER more than thirty-three years of service as chief entomologist of the United States Department of Agriculture, Dr Leland O Howard retired on October 17 as the chief of the Bureau of Entomology, and was succeeded by Dr C L. Marlatt, a member of the department since 1888 and who for the past five years has been associate chief in charge of the regulatory work of the bureau, and also chairman of the Federal Horticultural Board.

Dr Howard is now in his fiftieth year of government service, having joined the entomological branch of the Department of Agriculture in 1878, soon after his graduation from Cornell University. He retires as chief at his own request, but this does not mean retirement from service He has passed his seventieth birthday, and has asked to be relieved of the administrative duties of his office, but proposes to devote his full energies to the field of entomological research, in which he has long been recognized as a most distinguished investigator. His special fields are medical entomology and parasitology

Dr. Howard was placed in charge of the entomological work of the department on June 1, 1894. In the thirty-three years that have followed, the science of entomology has greatly broadened and Dr Howard has guided numerous activities which have been of great service to the American public

Two campaigns with which Dr Howard has been identified are especially widely known. He was a leader in the mosquito crusade As early as 1892 he published results of experiments showing that certain types could be controlled by the use of kerosene, and when the mosquitoes were identified as disease carriers he was able to recommend methods of control His publications on the house-fly dating from 1896 to his book "The House-Fly Disease Carrier" in 1911, were largely responsible for the anti-house-fly crusades all over the world in the last twenty years.

Dr. Howard is a member of the National Academy of Sciences, the American Philosophical Society, and the American Academy of Arts and Sciences. He was permanent secretary of the American Association for the Advancement of Science for twenty-two years, and its president in 1920–21 He has been made honorary member of many foreign scientific societies and is the only American honorary member of the Academy of Agriculture of France, and received several decorations, among which are the Cross, Chevalier de la Légion d'Honneur, and the Cross, Officier de l'Ordre du Mérite agricole He has been a delegate to many international assemblies and an officer of six scientific gatherings. In addition to bachelor's and master's degrees from Cornell, his doctorates include Ph D (Georgetown, 1896), M D (George Washington, 1911), LL D (Pittsburgh, 1911), and Sc D (Toronto, 1920). The bibliography of his publications includes 941 titles

Dr Marlatt, who succeeds Dr. Howard, joined the Department of Agriculture in 1888 and has been closely associated with Dr. Howard's administration When Dr Howard was made chief Dr Marlatt became assistant chief, and in 1922 associate chief in charge of regulatory work. He was instrumental in promoting the passage of the plant quarantine act of 1912 and was appointed to administer it Dr Marlatt's specialities have been studies of scale insects, sawflies and periodical Cicadas, known as locusts.

Dr Marlatt holds the degrees of B S, M S and D Sc, all from the Kansas State Agricultural College

SCIENTIFIC NOTES AND NEWS

DR. HOMER LEROY SHANTZ, for the past year head of the department of botany at the University of Illinois and previously senior physiologist in the U S. Bureau of Plant Industry, has been elected president of the University of Arizona, his appointment to be effective in September, 1928 Dr Byron Cummings, head of the department of archeology, who has been acting president since the resignation of Dr C H Marvin last February, has been named president of the university for the present year

THE John Fritz gold medal of the Engineering Foundation has been awarded to General John J Carty, vice-president of the American Telephone and Telegraph Company, in recognition of having "done more than any other man toward the development of modern telephone engineering"

THE Leslie Dana gold medal, awarded annually to the person who has done most for the conservation of vision during the preceding year, was presented on October 18 to Dr Lucien Howe, of Buffalo.

DR. WILLIAM LISPENARD ROBB, dean of electrical engineering at Rensselaer Polytechnic Institute, Troy, N. Y., has been awarded a 35-year service medal by the Hartford Electric Light Company, having entered the service of the company in 1892 in an advisory capacity and continuing to perform this service.

DR. JOHN M. T. FINNEY, professor of clinical surgery of the Johns Hopkins University School of Medicine, Baltimore, will be guest of honor of the Medical Club of Philadelphia on October 28 at a reception at the Bellevue-Stratford Hotel.

DR. JOHN STEWART, dean of the faculty of medicine at Dalhousie University, celebrated the fiftieth anniversary of his graduation on October 6, when a dinner was given in his honor in the Halifax Hotel. During the dinner Dean Stewart was presented with an address and a purse of gold.

DR. KARL SICK, professor of surgery at Hamburg University, has been nominated an honorary professor by the Turkish government for his help in the organization of medical education in Turkey.

AT the International Dental Congress recently held at Copenhagen the executive committee awarded the Miller prize, founded in 1910, to Professor Wilhelm Dieck, director of the Dental Institute of the University of Berlin.

THE University of Rome has conferred on Professor Fernando Perez, ambassador of Argentina to the king of Italy, the degree of doctor of medicine and surgery *honoris causa*.

AT the annual meeting of the trustees of the Mt. Desert Island Biological Laboratory the following officers were elected: Dr. Hermon Carey Bumpus, *president*; Professor Duncan S. Johnson, *vice-president*; Mrs. Louise DeKoven Bowen, *treasurer*; Dr. H. V. Neal, *secretary*. Dr. Neal was reelected director of the laboratory.

AT the meeting of Sigma Xi at the University of Virginia on October 17, the officers for the year 1927–28 were elected as follows: Wilbur A. Nelson, professor of geology and state geologist of Virginia, *president*; L. G. Hoxton, department of physics, *vice-president*, and Bruce D. Reynolds, department of biology, *secretary-treasurer*.

DR. IRVING CUTTER, dean and associate professor of medicine, Northwestern University Medical School, was elected president of the Phi Rho Sigma Medical Fraternity at the fifteenth biennial convention in Montreal from September 14 to 17.

DR. FREDERICK P. GAY, professor of bacteriology at the College of Physicians and Surgeons, Columbia University, has been made a member of the commission appointed to make a world survey of epidemic encephalitis.

LAURENCE LA FORGE has resigned as geologist in the U. S. Geological Survey.

WILLIAM G. HOUSEKEEPER has resigned from the technical staff of the Bell Telephone Laboratories, Inc., of New York, N. Y.

ELMER O. KRAEMER has resigned from the assistant professorship in colloids, which he held at the University of Wisconsin, and has joined the staff of the Experimental Station of E. I. du Pont de Nemours and Co., Wilmington, Del.

S. F. SCHAIRER, graduate student in the department of chemistry at Yale University, has joined the staff of the geophysical laboratory, Carnegie Institution of Washington.

PROFESSOR WILLIAM M. CLAY, of the biology department of Transylvania University, Lexington, Kentucky, has been appointed curator of the Transylvania Museum of Natural History.

W. A. MATHENY has been appointed director of the University of Ohio Museum.

SIDNEY B. HASKELL, director of the Massachusetts Agricultural Station and acting head of the division of agriculture at the Massachusetts Agricultural College, has resigned. He will assume a position with private interests in New York City.

M. BARRY WATSON has resigned from the position of director of engineering in the Toronto Technical Schools and is entering consulting practice.

THE staff of the University of Michigan Southern Observatory in South Africa has been increased by the addition of Mr. Morris K. Jessup and Mr. Henry F. Donner, who will assist Professor Richard A. Rossiter there in the study of double stars.

DR. ANDREW W. SELLARDS, assistant professor of tropical medicine at the Harvard Medical School, has been granted leave of absence for the academic year 1927–28 and will go to West Africa to make a study of yellow fever and other tropical diseases.

CHARLES W. CUNO has resigned his position at Washington University, St. Louis, Mo., and is to be at Göttingen, Germany, for the coming year as visiting professor, lecturing on "American Practice in Industrial Chemistry and Metallurgy."

DR. CHARLES L. SWISHER, professor of physics at the North Dakota Agricultural College, has been granted a leave of absence for the coming year, in

order to fill an appointment of assistant professor of physics at Yale University.

In response to invitations from the International Office of Museums and the British Royal Commission on Museums, Laurence Vail Coleman, director of the American Association of Museums, sailed for Europe on October 15

Dr. C G Abbot, of the Smithsonian Institution, has returned to Washington after the summer's field-work at Mt Wilson, California.

Dr Eugene R Whitmore, professor of parasitology and pathology at Georgetown University medical and dental schools, returned to Washington in time to take up his class work on the opening of school, after spending the summer in the West Indies and Central America studying malaria and blackwater fever.

Professor C. T Brues, of the Bussey Institution, Harvard University, has returned from an excursion into Nevada, Utah and eastern California, where he spent the summer in an investigation of the fauna of the hot springs in this region He was accompanied by Mrs. Brues, who made observations on the grass flora associated with the thermal springs, and by their son, who secures data on the characteristics of the thermal waters

C E Resser and R S. Bassler, of the department of geology, U S National Museum, have returned from two months' field-work in the Rocky Mountain region of both the United States and Canada, where they obtained certain stratigraphic information necessary to complete an extended work upon the region by Dr Charles D Walcott.

Dr. M O. Malte, chief botanist of the National Museum, Canadian Department of Mines, who accompanied the 1927 expedition to the Canadian Arctic archipelago, has returned with a large collection of botanical material.

W F. Foshag and Harry Berman have completed a trip to mining districts in northern Mexico, conducted under the auspices of the U. S. National Museum and the mineralogical museum of Harvard University, for the purpose of collecting exhibition specimens of the minerals of the region.

Dr. Jean Dufinoy, of Arcachon, France, has been sent to Cornell University by the Rockefeller Foundation for special study in the department of plant pathology.

Drs. Paul Alexandroff (Moscow) and Heinze Hopf (Berlin), holders of International Education Board fellowships for 1927–28 for the purpose of becoming acquainted with the work of American mathematicians in the field of analysis situs, are now at Princeton University and will go to Harvard University later.

Dr. Paul Walden, professor of chemistry at the University of Rostock, holder of the George Fisher Baker non-resident lectureship in chemistry this term at Cornell University, opened his course on October 5 with a discussion of modern chemistry's relation to ancient alchemy.

Professor Alexander Silverman, head of the department of chemistry of the University of Pittsburgh, gave an illustrated lecture on "Glass" before the Akron Section of the American Chemical Society on September 29

Dr. Raoul Blanchard, professor of geography in the University of Grenoble, France, lectured on October 19, at Columbia University, under the auspices of the Institute of Arts and Sciences

Professor Garwood, F R S, gave his presidential address, "The Development of River Meanders," to the Westminster and Central London branch of the Geographical Association on October 12, at University College

Sir John Rose Bradford, president of the Royal College of Physicians, will deliver an introductory address on "The Study of Medicine" at the opening of the winter session of the Durham College of Medicine, Newcastle-on-Tyne, on October 11

Friends and colleagues of the late Professor Adrian Stokes have decided to establish a memorial in recognition of the man and his work, through the establishment of a Stokes research fellowship or studentship, at the medical school of Guy's Hospital, London.

The Helminthological Society of Washington, of which Eloise B Cram is president and Mabelle B Orkman corresponding secretary, has passed the following resolution. "The members of the Helminthological Society of Washington learn with profound regret of the death of Dr. Henry J Nichols. His death is a distinct loss to science and medicine, in which fields he was a distinguished and able worker, as well as the loss to us of a highly esteemed friend. We extend our sincere sympathy to his family in their bereavement and to the Army Medical Corps in the passing of a beloved comrade."

Dr. Frederick Charles Newcombe, professor emeritus of botany and former head of the department of botany at the University of Michigan, died in Honolulu, T. H, on October 1, aged sixty-nine years. Dr. Newcombe was taken ill aboard ship while return-

ing from a trip to the mainland and died the morning after arrival in Honolulu.

Professor Perley F Walker, dean of the school of engineering of the University of Kansas since 1913, committed suicide on October 17 Dr Walker was fifty-two years of age

Dr Frank Sherman Meara, professor of clinical medicine at the Cornell University Medical College, died on October 9, aged sixty-one years

It is announced from the Carnegie Institute of Technology in Pittsburgh that a second International Conference on Bituminous Coal will be held there during the week of November 19, 1928 Decision to call a second congress of world scientists and fuel technologists has been made as a result of the interest aroused by the first conference on bituminous coal held at the institute in November, 1926 Although no definite program plans for the second conference have been made, it is expected that the session will cover the latest developments in obtaining substitutes for gasoline from coal, power from coal, low and high temperature distillation processes, smokeless fuel, gasification of coal, utilization of coal tar products, coal as a source for fertilizer and coal in relation to the production of fixed nitrogen Dr Thomas S Baker, president of the Carnegie Institute of Technology, who called the first conference, visited Europe this past summer for the purpose of discussing phases of the second conference with eminent scientists in France and Germany. He plans to pay another visit to Europe in 1928 to invite speakers and delegates.

Members of the American Association of Variable Star Observers met on October 22 at the Harvard College Observatory for their sixteenth annual meeting Miss Alice H Farnsworth, of Mt Holyoke College, vice-president, presided The president, C. C Godfrey, of Stratford, Conn., died in August. It was announced that he had left all his astronomical instruments to the association The council elected D B Pickering, of East Orange, N J, *president*, and reelected Miss Farnsworth, *vice-president*, Mr. Olcott, *secretary*, and M J Jordan, of Boston, *treasurer*

Utilization of cut-over lands for reforestation will be discussed at a conference of business interests of the country called under the auspices of the U S Chamber of Commerce on November 16 and 17 Possibilities of using the 29,000,000 acres of forest area in the Middle Atlantic region in order to assure the industrial East a continuous source of wood supply from its own natural resources will be considered The meeting, the first of its kind to be held, will bring together representatives from all sections of the country

At the International Congress of Plant Sciences (Fourth International Botanical Congress) held at Ithaca, New York, in August, 1926, an invitation was conveyed from British botanists for the fifth International Botanical Congress to be held in England in 1930 The invitation was accepted by the botanists assembled at Ithaca, and arrangements are now being made for the congress to be held at Cambridge about the middle of August, 1930 The *Journal* of the New York Botanical Garden states that an executive committee has been formed to make arrangements for the congress, consisting of Dr. F F. Blackman, Professor V H Blackman, Dr. E J Butler, Professor Sir John Farmer, Professor F E Fritsch, Professor Dame Helen Gwynne-Vaughan, Dr A. W Hill, Professor W Neilson Jones, Sir David Prain, Dr A. B Rendle (treasurer), Professor A C Seward (chairman), Professor W Stiles and Professor A G Tansley. It has been decided to organize the congress in the following seven sections Morphology (including anatomy), paleobotany, plant geography and ecology, taxonomy and nomenclature, genetics and cytology, physiology and mycology and plant pathology Mr F T Brooks, the botany school, University of Cambridge, England, and Dr T F Chipp, Royel Botanic Gardens, Kew, England, have been appointed honorary secretaries of the congress, and any communications with regard to the congress should be addressed to one or other of the secretaries

The courses of lectures at the Royal Institution during November and December will begin on November 1 with the annual course of three Tyndall lectures, which will be delivered by Sir Herbert Parsons on the subject "Light and Sight." These will be followed on November 22 by four lectures by Sir William Bragg on "A Year's Work in X-ray-crystal Analysis." Mr James Kewley will give two lectures on "Petroleum Natural Gases and their Derivatives" The Saturday lectures will include two lectures by Dr. F. J. M. Stratton on "Recent Developments in Astrophysics" The 102nd course of Christmas lectures for juveniles will be delivered by Professor E. N. da C Andrade on "Engines," beginning on December 29

The auxiliary yacht *Carnegie*, a ship that has very little iron or steel in its construction and is almost totally non-magnetic, left New York on October 12 under tow for Washington, where preparations for the seventh scientific cruise will be completed. The boat, which is owned by the Carnegie Institution, will leave next May on a three-year trip which is expected to cover all the oceans of the world, collecting data on ocean currents, magnetic phenomena and similar subjects.

Cash prizes totalling $6,000 are being offered to freshmen in American colleges for essays on subjects related to chemistry by the American Chemical Society, with the endorsement of Mr and Mrs F. P Garvan, of New York City. The essays must be on the relation of chemistry to health and disease, to the enrichment of life, to agriculture or forestry, to national defense, to the home or to the development of an industry A contestant may submit only one essay and this must not exceed 2,500 words in length The essays must be handed in to the Secretary, Committee on Prize Essays, American Chemical Society, 85 Beaver Street, New York City, before March 1, 1928

The first exhibition of material collected by the recently returned John Borden-Field Museum Expedition to Alaska is now open to the public at Field Museum of Natural History The exhibit consists of a wide variety of ethnological specimens representative of the life of the Eskimos of Alaska and northern Canada, and illustrates their fine craftsmanship, artistic skill and practical ingenuity The exhibit is a selection from a total of 533 pieces brought by the Borden party Other material, consisting of bows and arrows, snowshoes, stone cooking vessels, lamps, fishing equipment, etc, will be used later in reinstalling the entire Eskimo collections of the museum

The production of fur-bearing animals in Alaska is to be studied under a cooperative agreement recently made between Governor George A Parks, of Alaska, and the U S Bureau of Biological Survey Dr Earl Graves, veterinarian, has been selected to conduct the study He will go into the problems incident to the production of fur for commercial purposes and advise fur farmers of Alaska in matters pertaining to the breeding and care of fur-bearing animals and the prevention and cure of diseases among them The study will be carried on in cooperation with the Alaska Game Commission, the United States Forest Service, fur farmers' organizations and other agencies The sum of $15,000 has been appropriated by the Territory for expenditure in the project in 1927 and 1928, in addition to funds that may be allotted by the Biological Survey from its regular appropriations.

As part of the plan to put all available data of interest to engineers into a convenient published form for use in connection with various engineering projects, the magnetic declinations in each state are being published by the United States Coast and Geodetic survey, according to an oral statement made to a representative of the *United States Daily*, by the editor, Roy Griffith. The publications will appear by states. The volumes for Arkansas, Florida, Missouri and North Carolina are already available, and those for California and Nevada are now in the press. These volumes give the variations of the magnetic needle from the true north and enable local surveyors to correct their compass readings according to the latest scientific findings Descriptions and elevations of tidal bench marks in coastal states are also being published Separate volumes for New York, Rhode Island and the District of Columbia have been printed and the tables for Connecticut are in the press. These books give the elevations above sea level necessary in such work as harbor construction and city planning.

A tract of thirty-nine acres of spruce-covered land on the westerly side of Watatic Mountain in Ashburnham, Mass, recently bought by the Associated Committees for Wild Life Conservation, has been formally turned over to the Commonwealth as a gift from the committees, to be used as a wild life sanctuary for all time It adjoins the land which was given to the state by the Federation of Bird Clubs of New England Announcing receipt of the land the State Division of Fisheries and Game says "These gifts further emphasize the splendid work which the federation and the allied committees have done in bringing about the establishment of wild life sanctuaries To the thinking conservationists of the country it has been apparent for some years that our only hope to maintain a permanent and sufficient stock of desirable forms of wild life is through the establishment of such permanent sanctuaries"

UNIVERSITY AND EDUCATIONAL NOTES

Lafayette College has received from Mr John Markle, of New York, $500,000 for the construction and endowment of a building for the engineering department

Ground was broken for the new building of the Neurological Institute on October 19, adding another unit to the Columbia University medical center being constructed at 168th Street, New York.

The cornerstone of the Mines Building of the University of Utah will be laid early this month. The building, costing $50,000, will be used exclusively by the research department of the mining division of the university and by the intermountain station of the United States Bureau of Mines.

At the Armour Institute of Technology, Professor Donald F. Campbell has resigned and Associate Professor C. I. Palmer has been promoted to a full professorship of mathematics. Professor Palmer is also acting dean of students.

Associate Professors J. H. Kindle and Edward S.

Smith have been promoted to professorships of mathematics at the University of Cincinnati.

NEW appointments have been made to the medical staff of Dalhousie University as follows. Dr. R P. Smith, of Edinburgh and Durham, has been appointed professor of pathology and bacteriology and fills the vacancy created by the resignation of Dr A G. Nichols, Dr G S Eadie, of Toronto, who has spent the past two years at the biochemical institute of Cambridge University, has been appointed assistant professor of physiology; Dr Elizabeth Smith Bean, formerly of the University of Wisconsin, has been appointed instructor in histology and embryology. Dr. Howard A Jamison, of Glasgow, comes to the university as assistant in pathology and bacteriology, and G A Grant fills a similar position in the department of biochemistry

HAROLD B PIERCE has resigned as Fleischmann research fellow at the University of Rochester and has again assumed his duties as associate professor of dairy and food chemistry in the department of agricultural and biological chemistry at the Pennsylvania State College.

DR. PERRY YATES JACKSON, instructor in physiological chemistry at the University of Chicago, has been elected to a professorship in the department of chemistry at Park College, Mo

DR WILLEM JACOB LUYTEN, astronomer at the Harvard College Observatory, has been promoted to assistant professor of astronomy

NEW appointments in the college of engineering and architecture at the University of Minnesota include C A Hughes and J. A Wise, assistant professors of structural engineering Mr Hughes comes from the University of Toronto and Mr Wise from the Corps of Civil Engineers of the U. S Navy

AT Lafayette College, Ernest M. Fernald, of Cornell University, has been appointed assistant professor of mechanical engineering and Anson W. Voorhees, assistant professor of geology.

AT the University of Buffalo, Dr George Claude Hicks has been appointed assistant professor of biology, George E Read, instructor in physics, and Dr. Reginald Pegrum, instructor in geology.

DR M. A. GRAHAM, associate professor of chemistry at Mills College, has been appointed professor of chemistry at the Dominican College of San Rafael

DR PAUL A. MURPHY, formerly head of the plant diseases division, Department of Agriculture, Irish Free State, has been appointed to the newly created professorship of plant pathology in University College, Dublin.

DISCUSSION AND CORRESPONDENCE

EXIT THE TENTAMEN, BUT . . .

DR. HOLLAND in his recent letter to SCIENCE (July 1) has noted the decision of the International Commission on Zoological Nomenclature that that two-page work was not published, but was intended as a circular letter He does not mention, however, that the *names* involved are not thereby eliminated, but are merely thrown back on later publications, and is entirely silent on the extraordinary confusion that will result from the fact that these later concededly valid uses are in general incidental, rarely naming a type or indicating the intended contents of the genera, or in any way defining them save by citing some one or more species as belonging to them.

For instance, take Limnas, which Dr. Holland mentions. In 1806 it appears in the Tentamen with the well-known species *chrysippus* (Linnaeus). Then in the period 1806–1816, but at dates that are not more exactly known, Hübner figures 16 species of Limnas in the "Sammlung Exotischer Schmetterlinge," thereby firmly fixing the name in a work that every one agrees is published. Incidentally a prospectus in our library shows that 15 Limnas were published in March, 1814. After that he abandons the name, and bases his binary nomenclature (which now becomes strictly binomial) on a series of "coitus" names, from the "Verzeichniss," which began to be published at that time. Later Boisduval on a plate of the Buffon Series, figures a *Limnas pixe*, belonging to a group which is not related to *chrysippus* L, but which *is* related to forms which Hübner excludes from Limnas. The corresponding text was never published. Then the question rises: Is the type of Limnas the first species published in the "Sammlung," which is now unknown, but may be fixed any time by the discovery of a new dated advertisement of the "Sammlung"? or does the ghost of the "Tentamen" fix it to *chrysippus* as soon as valid publication occurs? or does it become *pixe*, a species which Hübner did not know? or do we reject all this, and hunt for the first attempt at a *formal* founding of the name, all these uses being in a sense incidental and assuming that the Tentamen had established the name? or finally do we adopt the name from Hübner's "Systematisch-Alphabetisch Verzeichniss" of 1822, which every one admits was published, but which so far as I can find no one in America has seen? And in the last case does the name actually appear there? Some one in Europe who has a copy will have to answer that. Meanwhile what shall we do with the Danaids of the *chrysippus* group and the Erycinids of the *pixe* group?

Again, take Coleophora, which was in universal use for the best part of a century, and which is still in

99 per cent. of our literature. If we ignore the "Tentamen," it is preoccupied by Haploptilia, published somewhere about 1826. And it again was not formally founded so far as I can find out, but Zeller began to use it (doubtless from the Tentamen) about 1838 when he felt the need of a genus name for the group

Nine tenths of the Tentamen names are now left in similar states of uncertainty. What would Dr. Holland do about it?

Incidentally I note an error or two in Dr Holland's statement As to the Tentamen being unused until Scudder recovered and reprinted it, it (or the names in it) was used by Hübner himself in the "Sammlung Exotischer Schmetterlinge" (for ten years), and it is said in the "Systematisch-Alphabetisch Verzeichniss," his last formal lay-out of the system, also by Ochsenheimer and Treitschke, Stephens, Herrich-Schaeffer, Zeller, Boisduval, Curtis and T W. Harris None of these authors adopted *all* the names, as the law of priority was not strictly construed in those days, also most people then did not feel the need of so many genera Ochsenheimer specifically mentions the Tentamen, and Harris refers to Apatela as in common use Others cite "Hübner" as author Hübner himself says it was "partly accepted and partly rejected"—a true statement.

In bringing in the "Verzeichniss," Dr Holland does not mention that ten years had intervened, and that in the meantime Hubner had used all the Tentamen names of butterflies as generic (as the first names of binomials), also many of the moths This fact completely invalidates his argument

WM T. M. FORBES

CORNELL UNIVERSITY

PARASITIC COPEPODS

IN the *Sitzungsberichte* of the Vienna Academy of Science there recently appeared (vol. 133, p 613) a paper by Helene Kurtz upon two new parasitic copepods The first of these new species belonged to the genus Achtheinus, and in dealing with it a question as to the validity of the genus was raised. This question was decided in the negative and it was stated that Achtheinus must be regarded as a synonym of Dana's much older genus Lepidopus. Such a conclusion might seem legitimate at first, but if we follow the steps by which it was reached we realize that the mode of reasoning employed is very defective.

In Dana's genus the first legs were uniramose and 3-segmented, the second, third, and fourth legs were biramose, the rami of the second pair 2-segmented, of the other pairs 1-segmented and rudimentary; the terminal segment of the maxillipeds was flattened into a broad lamina covered with scales, but without a claw. In Achtheinus on the contrary all four pairs of legs are biramose, the rami of the first 3 pairs 2-segmented, of the fourth pair 1-segmented; the maxillipeds have an ordinary terminal segment, with a stout terminal claw, but without scales.

Dana's type specimen has long since disappeared and no others have been obtained that could be identified with it, and hence it is impossible to verify or disprove his genus by any reexamination of specimens. In such a case the validity of the genus must rest upon the original description and the figures illustrating it. Fortunately both of these in the present instance are clear and decisive. Dana recorded the first legs as uniramose, and his figure showed a distinctively uniramose and 3-segmented leg, bearing no resemblance whatever to the first legs of Achtheinus, nor to either ramus of those legs. In the second legs also the basipod is long and narrow and extends out laterally, with the two rami fastened to the outer end, a very different type of leg from that found in the second pair of the genus Achtheinus

If Dana's genus is to be accepted at all, it must be given these exact details which he described and figured, and nothing can be added to them or subtracted from them. Especially is there no opportunity for conjectures or hypothetical inferences.

Stebbing in discussing South African Crustacea in 1918 (Annals South African Museum, vol. 17, part 1, p. 41) fully recognized these facts Although he did suggest that the first legs of Dana's specimen "might easily have lost one of the branches in the process of dissection," he nevertheless adopted the genus name Achtheinus and added "the merely conjectural identity of Lepidopus may stand aside."

Miss Kurtz must have failed to understand Stebbing's attitude in the matter for she adopted his suggestion but ignored his real conclusion Furthermore she carried the suggestion farther than he did by declaring that he had said that the endopod of the first legs in Dana's specimen was probably (wahrscheinlich) broken off. With this for a premise she argued that if the basal segment in the first legs of Dana's genus be regarded as the basipod, the other two segments would correspond to the exopod of the first legs in Achtheinus. And if we could find that "probably" broken-off endopod, and if it should prove to be 2-segmented when we did find it, then the first legs of the two genera would be similar. She considered this sufficient proof of the identity of the two genera and made Achtheinus a synonym of Lepidopus.

She disposed of the scaly covering of the terminal segment of the maxillipeds, which Dana used as the basis of his genus name, by saying that no such

structure had ever been found in the entire order of copepods, and hence Dana must have been mistaken in what he thought he saw. Steenstrup and Lutken described and figured a similar structure in the maxillipeds of their new genus Perissopus (Kongelige Danske Vidensk Selskabs Skrifter, ser 5, vol 5, 1861, pl 12, fig. 25), and there is every reason for believing the structure in both genera to be genuine.

Absolutely hypothetical reasoning like that quoted above can have but little influence, and it certainly does not possess sufficient merit to prove or disprove the validity of any genus

CHAS. B. WILSON
DEPARTMENT OF EDUCATION,
WESTFIELD, MASS

NEW DUST TREATMENTS FOR OATS SMUTS

SINCE the introduction of copper carbonate for wheat bunt control (Darnell-Smith, and Ross, 1919)[1] considerable interest has been shown in dust treatments for grain smuts. It was found by one of us (Thomas)[2] in field tests in 1924 that copper carbonate alone was not effective in controlling oats smuts. However, when one part of either copper carbonate or copper sulfate was mixed with two parts of mercuric bichloride the dust was effective These mixtures are too expensive for general use even though rapid and easy of application Other tests showed that the mixture was less effective when inert fillers were added In 1926 a mixture of one part of copper sulfate, one part of mercuric bichloride and one part of cresylic acid was found to control oats smuts While the cost of this dust was only about half that of the copper sulfate-mercuric bichloride dust, yet it is also too expensive for general use

None of these dusts, although they gave satisfactory control of oats smuts, was as cheap as the liquid formaldehyde This liquid treatment is objectionable because of the difficulty in handling the wet grain and the possibility of seed injury Since formaldehyde is so effective against smut, and the wet methods of grain treatment are objectionable, an attempt was made to put formaldehyde in a dust form. This was done by mixing 40 per cent formaldehyde with either infusorial earth or charcoal These dusts stick well and thoroughly coat the grains when mixed with them. In these tests dusts containing 9 per cent, 15 per cent and 25 per cent of 40 per cent. formaldehyde were used, each at the rate of 3 ounces per bushel of grain. While the checks showed 47 per cent. smut the various formaldehyde dusts reduced smut to less than one per cent.

Another new treatment, iodine vapor dust, was tried in these same experiments This dust was made by mixing finely ground solid iodine with infusorial earth The iodine vaporizes readily at ordinary temperatures and diffuses through the infusorial earth giving it a light yellow-ochre color. This dust contained 5 per cent by weight of iodine and was applied at the same rate as the formaldehyde dust. Only three smutted heads were found in three one-hundredth acre plots which were treated with this dust It is possible that lower concentrations of iodine dust will also control the oats smuts Further tests are under way The cost of treating grain with these dusts is estimated at considerably less than 5 cents a bushel

J D SAYRE
R. C THOMAS
OHIO AGRICULTURAL EXPERIMENT STATION,
WOOSTER, OHIO

[1] Darnell-Smith, G P and Ross, H A dry method of treating seed wheat for bunt *Agr Gaz N So Wales* 30 685–692, 1919

[2] Thomas, Roy C Dust treatment for smut in oats SCIENCE, No 1567, Vol. LXI· 47–48. January 9, 1925

DO CATS SHARPEN THEIR CLAWS?

LAST winter the family cat (castrated male, 3½ years old) shed a number of claws in the house. These were found during January and February, some of them split lengthwise, the others intact. It struck the writer that the shedding of claws is probably a normal phenomenon with cats comparable to related phenomena, as that of the shedding of horns by deer If this were true, it might be expected that some of the claws would be left in the bark of those trees which the cat used regularly for scratching. Upon investigation in April this bit of evidence was found in the form of two halves of a claw stuck into the bark of an elm and several halves lying under different trees used by the animal The section of the bark was cut from the tree and with the pieces of claws has been mounted and placed in the college zoological museum

This is but an isolated observation. There are good grounds, however, for believing the conjectured explanation to be correct Cats do not instinctively or from experience select good grinding surfaces, slightly rough and hard, such as a cement walk, the foundation stone or the corner boards of a house, or smooth hard posts. They make use of the rough bark of trees which is always much softer than their claws. Observations of their scratching movements show that the animals do not scrape downward over the surface of the object, but catch the claws into the surface and with a circular stroke pull first downward and then outward and slightly upward. Careful examination of the cat's paws each time when a

claw was found failed to reveal any sign of injury. It was impossible to identify the toe from which the claw had dropped. This strikes the writer as fair proof that the shedding of claws is a normal phenomenon. The claws of the rear feet are possibly lost as they become loosened, or they may be pulled out by the animal with his teeth. Cats are frequently seen to pull at their hind claws in a manner suggesting this.

The shedding of claws is most likely seasonal, as are the related phenomena in other animals. Why then should the cat carry on the scratching movements throughout the year? It is possible that a further function of the scratching may be that of keeping the claws from curving too much, consequently growing into and irritating the paw. The irritation caused by claws which are curved too much or by the itching or other annoyance of loose claws may be the stimulus that starts the scratching movements. In this connection a colleague, a zoologist, has called attention to a reaction of badgers. These animals frequently drop out of an intense fight, roll over on their backs and scrape the claws of their front paws by rapidly drawing the paws across each other, pads facing. In accounting for the continuation of the scratching activity throughout the year, however, the likelihood of this being a habit reaction must not be overlooked.

OLE N. DE WEERDT

DEPARTMENT OF PSYCHOLOGY,
BELOIT COLLEGE

RECENT PUBLICATIONS OF THE NATIONAL RESEARCH COUNCIL

Two recent publications in the National Research Council's *Bulletin* Series should be of rather wide interest among scientific men. One (Bulletin 58) is entitled "Handbook of Scientific and Technical Societies and Institutions of the United States and Canada." The American section of this bulletin was compiled by Clarence J. West and Callie Hull, and the Canadian section by the National Research Council of Canada. The other (Bulletin 60) is entitled "Industrial Research Laboratories of the United States, including Consulting Research Laboratories, Third Edition." This bulletin was compiled by Clarence J. West and Ervye L. Risher. Both bulletins are the output of the National Research Council's Research Information Service, of which Dr. West is director.

The purpose of publication of the handbook is to present a ready guide to those scientific and technical societies, associations and institutions of the United States and Canada which contribute to scientific knowledge or further research through their activities, publications or funds. Only those government institutions are included which administer private funds. Organizations directly controlled by universities or colleges have been omitted because it is expected that they will be covered by the forthcoming publication, "American Universities and Colleges," to be issued by the American Council on Education. Seven hundred and nine American organizations and seventy-four Canadian organizations are listed in the bulletin. The address of the secretary, the date of organization, the major object of the institution, the character of membership and amount of dues, time of meetings and information concerning publications are given for each institution.

The bulletin on Industrial Research Laboratories lists 999 such laboratories in the country, giving for each laboratory the name and address of the supporting industrial or commercial concern, the makeup of the research staff, and a list of special subjects to which the research activities of the laboratory are devoted. The first edition of this bulletin was published in 1920 and listed about 300 laboratories, a second edition (first revised edition) was issued in 1921 and listed about 600 laboratories. The present edition (1927) is the second revision of the bulletin.

The difficulties of compilation in connection with both of these publications make it inevitable that some errors, both of commission and omission, have been made by the compilers. The director of Research Information Service (National Research Council, Washington, D. C.) will be glad to have his attention called to any such errors noted by any who may have occasion to examine the bulletins.

VERNON KELLOGG

NATIONAL RESEARCH COUNCIL,
WASHINGTON, D. C.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PREPARATIONS OF STAINED DECALCIFIED BONE WHICH RIVAL GROUND SECTIONS

GROUND sections of bone, besides being difficult to prepare, are often unsatisfactory for student use either on account of their thickness or due to the fact that they have been mounted in thin xylol-balsam, resulting in the displacement of the air from the lacunar and canalicular spaces of the tissue. It is, however, possible to prepare decalcified bone in such a way that all the advantages of canalicular detail are obtained. Two methods by Schmorl,[1] the picro-thionin and the thionin-phosphotungstic acid

[1] 1909. Schmorl, G. "Die pathologisch-histologischen Untersuchungenmethoden." Vogel, Leipzig.

methods, give excellent results and the detail demonstrated surpasses that observed in ground sections. With the exception of a few departments of dental histology, neither of these methods is in general use in American laboratories I have been unable to find Schmorl's original description of his methods but they are repeated in a more recent work of 1909. An excellent discussion of the methods is also found in a paper on the structure of bone of Fasoli[2] and adequate directions for the successful use of these methods are given by Carleton[3] in his recent book on histological technique References to Schmorl's methods may also be found in the works of Lange[4] and Fischer[5] It seems unnecessary to completely outline the method since it can be readily obtained in English in a modern text-book on histological technique Formol, Orth's, Müller's or Regand's fluids may be used for fixing. Fluids containing mercuric chloride should be avoided Best results are obtained with celloidin or frozen sections If nuclear patterns are desired, the tissue should be first stained in alum-carmine or hemalum, as the success of the picro-thionin method depends entirely on the precipitation of the thionin in the lacunae and canaliculi The picro-thionin method is best adapted to work with old bone, while the phosphotungstic acid method is more useful for demonstrating the histology of young bone and the process of ossification.

ALDEN B. DAWSON

DEPARTMENT OF BIOLOGY,
NEW YORK UNIVERSITY

SOME FIXATIVES FOR BOTH NUCLEI AND MITOCHONDRIA

A 2.5 per cent. solution of copper bichromate C. P (Eimer and Amend) has a pH of 2.0. When root tips of Zea are fixed in it the fixation image is that of chromic acid, *i.e.*, the nucleolus appears as a spherical, darkly staining body in a hollow nucleus whose surface is composed of the chromatin reticulum. The mitochondria are either dissolved by the fixative or by the dehydrating alcohol. If, however, a slight excess of cupric oxide is added to the solution, the pH is altered to about 4.6 and the fixation image is greatly changed. There is here no hollow space around the nucleolus, the nucleus is a solid body, and in the resting stages the chromatin reticulum is much less distinct. In the dividing nucleus the spireme shows up distinctly and the chromosomes are well preserved. While the spindle fibers are not distinguishable individually, collectively they are well delineated. The mitochondria are well fixed and mordanted and can be followed through each of the mitotic stages. This fixative has the following faults. the resting nuclei show little detail, the cytoplasm is somewhat distorted and the outer layer of cells is generally over fixed. The addition of .05 per cent. acetic acid causes the resting nuclei to show more detail, though one must be cautious in the use of this acid, for a slight excess of copper acetate will dissolve the mitochondria. The most successful formula for the fixative is.

copper bichromate	5 grams
cupric oxide	1 gram
10 per cent sol acetic acid	1 c c
water	200 c.c

The material should be left in the solution for from 36 hours to six days, and when thus fixed both chromosomes and mitochondria are well stained with Heidenhain's haematoxylin. Destaining should not proceed as far as is usual for an examination of the nuclei, for the mitochondria do not hold the stain as well as the chromosomes and can be completely decolorized before the chromosomes have started to fade.

It is very important to make up the fixative at least 24 hours before it is to be used It must be shaken frequently in the interval and the excess copper oxide allowed to settle If it is used too soon the fixation image will be that of chromic acid. It is best to wash out the fixative with 70 per cent. alcohol. If the dehydration is too prolonged the mitochondria will be dissolved out of the peripheral cells. A half hour in each of 70 per cent., 85 per cent. and 95 per cent. alcohol, and an hour in each of two changes of absolute, are sufficient for the dehydration.

Another solution which fixes both chromosomes and mitochondria is:

chromium trioxide	5 grams
glucinum carbonate	3 grams
water	200 c.c

This also has a pH about 4.6. If there is no excess of glucinum carbonate a little more should be added, for otherwise the fixation image will be that of chromic acid. The fixed material should be dehydrated as described above. Material fixed in this solution appears very much like that fixed in the copper bichromate mixture; the cytoplasm is perhaps a trifle more granular and the mitochondria are thicker, otherwise the two fixatives are alike.

A third solution which fixes both chromosomes and

[2] 1905 Fasoli, G. "Ueber die feinere Struktur des Knochengewebes" *Arch. mikr Anat*, Bd. 66, S, 471.

[3] 1926 Carleton, H M. "Histological Technique" Oxford University Press.

[4] 1913 Lange, W. "Histologische Technik für Zahnärzte." Springer, Berlin

[5] 1910 Fischer, Bau und Entwicklung der Mundhöhle. höhle.

mitochondria apparently functions quite differently from the two just described. It is:

10 per cent sol. chromic sulphate............ 1 part
8 " " " formalin neutralized with an excess of $CaCO_3$ or Li_2CO_3............ 1 "

If calcium carbonate is used the pH is about 2.2, if lithium carbonate is used it is about 4.8.

When this fixative is washed out with water and the dehydration proceeds slowly, the dividing nuclei and the cytoplasm appear beautifully fixed. The chromosomes are a trifle shrunken so that in the metaphase they show the split very clearly. The cytoplasm appears quite smooth with sharply delineated vacuoles. In the root tip the growth of the vacuoles and their behavior during mitosis can be easily followed. Unfortunately the mitochondria are dissolved out of the epidermis and cortex and remain only in the central cylinder. If the fixative is washed out with 70 per cent alcohol and the dehydration is relatively rapid, the cytoplasm appears more granular and the mitochondria are preserved in nearly the whole tissue.

It is evident that there is an important relation between the pH of a bichromate and its fixation image. If it is too acid it will fix the chromatin but not the mitochondria, if it is too basic it will fix the mitochondria but not the chromatin. Certain bichromates in the presence of an oxide or a carbonate of the element which furnishes the cation will buffer at a point where they will fix both nuclear and cytoplasmic elements. Others, as their pH number is raised, suddenly change from nuclear to cytoplasmic fixatives. The pH of this point of change shows quite a range for the various bichromates. Thus ammonium bichromate pH 4.2 and potassium bichromate pH 4.4 are much too basic to fix the chromatin, while lithium bichromate pH 4.6 has the fixation image of chromic acid. Zinc bichromate pH 5.2 will fix both chromosomes and mitochondria with its characteristic fixation image.

A detailed description of the fixation images of various bichromates is being prepared.

CONWAY ZIRKLE

BUSSEY INSTITUTION,
HARVARD UNIVERSITY

SPECIAL ARTICLES

THE MnII SPECTRUM EXCITED BY RARE GAS IONS

THE MnII spectrum was excited by the method recently described by Duffendack and Smith[1] and tested by the writers[2] on the CuII spectrum. In this method rare gas ions on contact with Mn atoms ionize them and simultaneously excite them to the degree that the ionizing potential of the rare gas exceeds that of manganese, 7.4 volts.

An argon ion on contact with a Mn atom can ionize it and excite the resulting Mn^+ ion to the extent of $15.4 - 7.4 = 8.0$ volts. In the process the argon ion is neutralized by combination with an electron taken from the Mn atom and energy to the amount of 15.4 equivalent volts is made available. 7.4 equivalent volts of this is expended in extracting the electron from the Mn atom, leaving eight equivalent volts to be accounted for. Smyth and Harnwell and Hogness and Lunn[3] have demonstrated by positive ray analyses that ionization may occur upon contact between an ion and a molecule. In the investigations cited above[1,2] it has been demonstrated that the excess energy may go toward exciting the ion formed. Hence, when argon ions are used, one may expect to produce by this process Mn^+ ions excited to states whose levels are less than eight volts or 64,800 cm^{-1} above the normal state of Mn^+ but none excited to a higher degree. Consequently, lines of the MnII spectrum whose initial states are below 64,800 cm^{-1} should appear and lines originating in higher states should be absent from the spectrum thus excited. If, however, neon (ionizing potential 21.5 volts) is substituted for argon, Mn^+ ions excited to states whose levels are less than 14.1 volts or 114,210 cm^{-1} are produced and lines from these levels should appear in the spectrum.

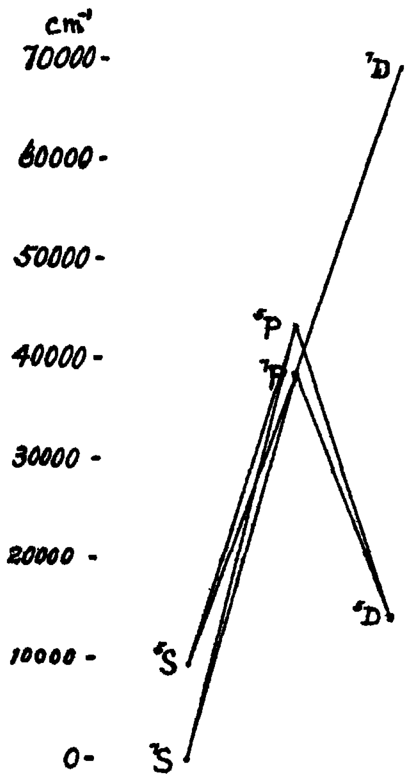
The experimental procedure consisted in photographing the spectra of low voltage arcs in mixtures of argon and Mn vapor and neon and Mn vapor in a tungsten furnace apparatus. The manganese was put into a molybdenum trough mounted inside a cylinder of thin sheet tungsten and insulated from it. This trough constituted the anode of the arc, and the cathode was a tungsten filament mounted inside the cylinder and parallel to its axis. The tungsten cylinder was itself mounted inside a metal water-cooled vacuum chamber, filled to the desired pressure with argon or neon, and was heated by passing a sufficiently large current through it. The manganese in the trough was thus vaporized and any desired vapor pressure could be maintained inside the cylinder. The filament was then heated and a low voltage arc maintained in the mixture of argon or neon and manganese vapor within the furnace. The spectrum of the arc was photographed through quartz windows sealed onto the vacuum chamber.

The results support the hypothesis outlined above. When argon was used, lines originating in the ^7P and

[1] *Phys. Rev.* 29, 914, 1927; *Nature*, May 21, 1927.
[2] *Phys. Rev.* 29, 925, 1927.
[3] *Nature*, Jan. 15, 1927; *Phys. Rev.* 29, 830, 1927; *ibid.*, 30, 26, 1927.

^5P levels (Fig 1) appeared in the spectrum but none from the ^7D level. When neon was substituted for argon and all other conditions kept the same as before, the $^7P - {}^7D$ lines came out strongly

This work led us naturally to the analysis of the MnII spectrum. In 1923 Catalan[4] published four multiplet arrangements in the spark spectrum of manganese which can easily be recognized as $^7S - {}^7P$, $^7P - {}^7D$, $^5S - {}^5P$, and $^5D - {}^5P$ The lowest term of the MnII spectrum may be expected to be the ^7S term and so the levels of the septet terms were immediately established, as shown in Fig 1 Catalan's multiplets



enabled us to determine the relative levels of the quintet system and so the first problem was to find intercombination lines which would fix the positions of the two systems with respect to each other. The difference $^5S - {}^7S$ can be estimated from convergence limits in the MnI spectrum[5] Dr O Laporte, who has given us valuable suggestions on the nature of the MnII spectrum, had recently calculated this difference and furnished us his result, 9,477 cm^{-1}. Using this value, intercombination lines were quickly found which fixed the difference at 9,474.3 cm^{-1} and established the relative positions of the two systems. Lines have been found for the transitions indicated in Fig. 1, and the work of completing the analysis of the spectrum is in progress The similarity of this spectrum to that of CrI is apparent from a comparison of their diagrams[6]

J G BLACK,
O S DUFFENDACK
PHYSICS LABORATORY,
UNIVERSITY OF MICHIGAN

FOG PRECIPITATED BY TREES

THE collection by vegetation of moisture from fog has interested me for a long time I recently found an opportunity to approximately measure the amount collected by trees.

During the summer west winds blow the moisture-laden air from the Pacific Ocean up and over the hills back of Berkeley, California Nearly every afternoon fog collects on the hills at elevations above 800 feet and stays until the morning sun dissipates it Occasionally it remains the entire day

About twenty-five years ago pine and eucalyptus trees were planted on the sides and tops of the hills over large areas which prior to that time were bare of all but grass Trees were found only in canyons, while brush covered many of the slopes, particularly those sloping to the north. These trees grew slowly for a number of years but have made very rapid growth in the dry years since 1917 The summers here are nearly rainless and all vegetation on the hills usually dries up during this rainless season, except in protected spots and in canyons where moisture is more plentiful.

I have long noticed that the soil beneath trees is more moist than elsewhere, the additional moisture coming from the collection of water from the fog dripping to the ground I recently (July 31) collected samples of soil from beneath trees and from ten feet from trees, where soil and other conditions were identical Samples were collected from surface to 12 inches depth and the moisture determined. Here are the results

	Percentage of Moisture	
	Under tree	Ten feet from tree
Monterey Pine—Elev 1,500 ft.	24 4	7 8
Monterey Pine—Elev. 1,600 ft	28.5	7 7
Eucalyptus —Elev 1,650 ft	22.9	9 4

Assuming the weight of soil as 90 lbs per cubic foot, these differences in percentage are equivalent to the following in inches of rainfall Pine, elevation 1,500 feet, 2.87 inches Pine, elevation 1,600 feet, 3.60 inches. Eucalyptus, elevation 1,650 feet, 2.33 inches. The soil was moist much deeper than 12 inches, so the total difference in inches of water collected is much above that shown.

The area of ground covered by trees, where the

[4] *Phil. Trans Roy Soc* 223, 127, 1923.

[5] McLennan and McLay: *Trans. Roy. Soc. Canada* 20, 15, 1926.

[6] Catalan: *Anales Soc. Esp. de Fis. y Quim.* 21, 84, 1923.

stand is full, approximates 25 per cent. of the ground area. The moist spots are under all trees where the wind blows up or over the slopes, in some cases moisture has collected fast enough to form puddles and run down the slopes in rivulets. Away from the trees the ground is dry as it usually is in summer

The trees average 15 feet in height for pines and 20 for eucalyptus, the trunks from 6 to 10 inches thick Small trees, brush and grass collect relatively little moisture

The effect of this additional moisture collected from fogs in the dry season is readily noticed in the rapidity of growth As the trees become larger their collecting area increases

THOS H MEANS

ACTION CURRENTS FROM MUSCULAR CONTRACTIONS DURING CONSCIOUS PROCESSES[1]

IN the course of investigations on the influence of general muscular relaxation[2] upon the occurrence of various types of conscious processes, we arrived at a fairly uniform result After a period during which relaxation had been sufficiently advanced and generalized, all the subjects (23) who had been adequately trained as judged by certain tests agreed, under controlled conditions, in giving independent reports that there had been for the time a notable diminution or virtually total disappearance of conscious processes. These included not alone so-called kinesthetic activities but also visual and auditory imagery, attention, reflection and emotion Extreme relaxation of the muscles of the eyes and of speech seemed of conspicuous importance

When these subjects were requested to engage in reflection or other conscious activity, but at the same time to seek to relax extremely, they reported that they did one or the other but could not do both Extreme relaxation was found to be incompatible with the simultaneous presence of conscious activities When the subjects relaxed extremely to a point where they later reported diminution or absence of mental activity, the muscles of the eyes and face assumed a flaccid appearance which gave characteristic photographs. Association time was greatly prolonged or no associations appeared The subjects, who were highly trained in observing and critically reporting their sensory experiences, agreed in discerning an experience as of a muscular contraction occurring at the moment of conscious activity and appearing to constitute a part of the conscious process. We are reminded of the assertion of Hughlings Jackson that a motor element is involved in every conscious activity

To test this conclusion from another direction, we have begun to employ the string galvanometer with vacuum tube amplification Ours is the first application of that instrument (unpublished in 1921), we believe, to the question whether action currents are given off by muscular contractions associated with imagery, reflection, attention and other conscious processes. Early tests in a preliminary way without amplification on imagined flexion of the biceps brachial group have given positive results It is necessary, however, to control the methods very carefully and to apply the tests to various parts of the musculature during various types of conscious processes, before the foregoing conclusions can be adequately tested or confirmed This is now being done.

EDMUND JACOBSON

HULL PHYSIOLOGICAL LABORATORY,
UNIVERSITY OF CHICAGO

[1] Preliminary report.

[2] Jacobson, E. 1924 *Jour of Nerv and Mental Dis*, LX, 568. 1925. *Am. Jour. of Psychol*, XXXVI, 73

THE NATIONAL ACADEMY OF SCIENCES

AT the annual meeting of the National Academy of Sciences, held in Urbana, on October 18, 19 and 20, at the University of Illinois, the following papers were presented

Further evidence on the constancy of the light of stars JOEL STEBBINS At the Washburn Observatory, University of Wisconsin, tests of the light of different classes of stars have been made by the writer and C. M. Huffer From the samples studied it is inferred that white and yellow stars are fairly constant in their radiation, but that the red stars are likely to vary in light, particularly the very red and relatively cool bodies. The amount of the change is often ten or twenty per cent within two weeks or a month Nearly one third of the red stars in general, and all of the largest stars like Betelgeuse, are variable in this fashion. It is probable that the surfaces of these stars are covered with spots like those on the sun, and that the bodies are in early stages of development

An attempt to detect the Einstein displacement at the limb of Jupiter PHILIP FOX (introduced by Henry Crew) The displacement of star images at the limb of the sun observed at the time of total eclipses has been demonstrated by several observers with values closely approximating the amount predicted by Einstein On April 28, 1923, Jupiter occulted the star BD–14° 4069 The circumstances of this phenomenon were observed at the Dearborn Observatory A series of plates were exposed successively as Jupiter approached and receded from the star. This note presents the results of the observations and the plans for a similar occultation which will occur on the evening of December 7, 1927.

An after-image of the yellow spot: J. McKeen Cattell. Loewe, Haidinger, Clerk Maxwell and Helmholtz have described in detail the entoptic phenomena connected with fovea centralis and the yellow spot. If one looks at a blue surface or preferably through a blue glass or a solution of chrome alum, a dark spot appears in the center of the field of vision. Skilled observers may see a dark halo with a bright ring surrounding the spot. The observation here put on record is that after the retina has been fatigued by the blue light, if the eyes are turned to a white surface, say the clouded sky, a bright yellowish after image of the yellow spot appears, comparable to the sun seen through the clouds. The yellow spot has been protected from the blue light by its pigment and is relatively more sensitive to the white light. Another observation that may be put on record is that about twenty five years ago I obtained an after image that still exists. The after image followed exposure of the eyes for one minute to the clear sky through the cross-bar of a window. This positive after-image, which I can now see with closed eyes, may be due to permanent changes then caused in the retina, or it may be reinforced by attention. Newton describes an after image of the sun that lasted three years.

Presbyota and the causes of deficient hearing: J. McKeen Cattell. Presbyopia is well known, but in so far as there is an analogous condition of the organ of hearing it has been so little considered that a new name must be invented for it. Oliver Wendell Holmes noted that in old age tones of high pitch, as the chirping of a cricket, can not be heard, and the upper limit of audible pitch is now measured by the Galton whistle and other methods. In the Bell Telephone Laboratories Dr Harvey Fletcher, following work of Professor Seashore and others, has recently perfected an audiometer for measuring acuity of hearing for tones of different pitches, records from which are exhibited. Attention is here called to the fact that deficiency of hearing is due not only to failure to respond to the energy of the stimulus as measured by the audiometer, but also to the fusion of successive stimuli and that this condition may be normal after middle life. Vision is a space sense, hearing a time sense. The inertia of eye and the fusion of visual sensations have been thoroughly investigated, but we have no corresponding information in regard to the fusion of auditory sensations. Sounds separated by one five-hundredth of a second can be discriminated, but with speech sounds given at longer intervals are fused. We can speak about as rapidly as we can hear—some twenty changes a second—and this may have evolutionary significance. In order to be heard by one of deficient hearing, or by an audience, it is necessary to speak not more loudly, but more distinctly and more slowly. The conditions are analogous to the loud speaker of the radio or to transmission on the telephone line, where increased loudness increases the distortion and blurring of the waves. As the muscular system of the eye controlling the curvature of the lens becomes flaccid with age, so the receptor in the ear may be expected to lose its elasticity with age. It does not respond to the more rapid vibrations and has greater inertia, so that a longer period is required to set it in motion and the motion may subside more slowly. There is consequently fusion of successive sounds, which are besides less distinctive because the higher overtones are lacking. A loss of acuity of hearing of 30 per cent is a small matter, for one can hear a conversation as well at six feet as at three, but the fusion of successive stimuli makes close attention necessary and explains the difficulty that older people experience in listening to an address or theater performance.

The correlation between intelligence and speed in conduction of the nerve impulse. Lee Edward Travis (introduced by C. E. Seashore).

The collection of Negro songs by phonophotography. Milton Metfessel (introduced by C. E. Seashore).

Environment and context. Madison Bentley (introduced by S. A. Forbes).

The beginnings of cerebral cortex. C. Judson Herrick. The lowest vertebrates have no fully differentiated cerebral cortex, that is, superficial gray matter in the forebrain. This appears first in reptiles. In the Amphibia cortical territory can be recognized, but true cortex is not differentiated within it. An analysis of this territory reveals the physiological factors operating in a phylogenetic stage just antecedent to the appearance of true cortex. The intrinsic functions of association, so characteristic of human cortex, here provide the physiological motivation for the actual differentiation of cortex as we see it in reptiles. Yet no cortex appears in Amphibia. The reason is that a certain measure of anatomical localization of function in cortical territory is prerequisite for the appearance of cortex in this territory. The Amphibia have three local fields of "primordial cortex," but only two of these have specific connections through projection fibers with distinctive subcortical reflex centers. In reptiles the third field also has acquired its own system of such projection fibers. Cortex never appears in a single isolated field, but at least three fields with distinctive subcortical connections are necessary for its differentiation, which occurs simultaneously in all of them.

Studies on the thyroid. A. J. Carlson.

The effect of raised intrapulmonic pressure upon the knee jerk, arterial blood pressure and state of consciousness: Arno B. Luckhardt (introduced by A. J. Carlson). In the dog raised and maintained intrapulmonic pressure leads to a sharp drop in the general arterial blood pressure accompanied by a diminution of the knee jerk or its complete abolition. The effects on the knee jerk center are due, for the most part, to changes in the circulation through the brain and cord (anemia and asphyxial depression). The diminution of the knee jerk may in part be due to reflex inhibition of the knee jerk center as a result of stimulation of the sensory fibers of the pulmonary vagus. A similar drop in general arterial

pressure results in man from a forced and maintained increase in intrapulmonic pressure. The drop in pressure in man and dog under conditions of raised intrapulmonic pressure is due to an interference with the filling of the left heart Depending on the extent of the drop in the general arterial blood pressure, there ensues giddiness or arterial unconsciousness The compensatory after fling in the blood pressure (on release of the intrapulmonic pressure) is responsible for the symptoms of nausea, fullness of the head and general discomfort.

Studies of conditioned reflexes N. KLEITMAN Dogs with salivary fistulae were placed in a stand for a period of time varying from 15 minutes to two hours, and were then given an injection of morphine subcutaneously Daily repetition of this procedure resulted in the development of a conditioned salivation starting as soon as the animals were put in the stand The curve of development of this conditioned reflex is S shaped, showing first a positive acceleration and then a negative one The extinction of the conditioned reflex when the daily injections are discontinued follows a concave curve, which in some dogs is a second degree parabola The abolished conditioned reflex may be reestablished by resuming the injections of morphine, and it reaches its height of development in less time than it takes to establish it for the first time The establishment, extinction and reestablishment of the conditioned reflex resemble closely learning, forgetting and relearning nonsense syllables Starvation acts deleteriously on the course of the fully established reflex or prevents its proper development. This is not due to a decrease in water consumption observed in fasting, nor to a decrease in size of the salivary glands. It is probably due to a depression of the activity of the centers in the nervous system resulting from starvation

The action of trypanolytic sera in vivo WILLIAM H TALIAFERRO (introduced by S A Forbes) Mice infected with *Trypanosoma equinum* exhibit a progressive infection with a constant increase of the parasites in the blood until death which occurs on the fifth or sixth day in our strain If, however, a suitable dose of trypanolytic serum (serum obtained from guinea pigs, rabbits or sheep after a natural trypanolytic crisis) be injected into an infected mouse, there is a lysis of the parasites (crisis) in about one hour, then a period of several days in which no parasites can be found in the peripheral blood and eventually a relapse during which the parasites increase steadily until the death of the mouse. The length of life of such treated mice is prolonged over that of untreated controls about as long as the crisis lasts. A peculiar anomaly sometimes appears when a series of infected mice at the same stage of infection are given different amounts of lytic serum Doses of lytic serum greater than the minimal effective dose instead of all producing lysis of the parasites show recurrent zones of effectiveness and non-effectiveness. This zonal phenomenon is superficially similar to the animal experiments of Pfeiffer (1895) and others on the protective (as distinguished from the present curative experiments) action of antibacterial sera and to the so-called Neisser Wechsberg phenomenon in test tube experiments Such peculiarities in the action of immune serum in the animal body, besides its theoretical interest, may have a distinct bearing on the use of immune sera in the treatment of disease In *T equinum* the occurrence of zonal phenomena is directly correlated with the number of trypanosomes present in the blood at the time the immune serum is administered In one strain (experiments of T L. Johnson) if there are from 1 to 5 parasites per microscopic field when the lytic serum is given there is no zonal phenomenon, but all doses greater than the minimal effective dose are similarly effective If, however, there are from 9 to 33 parasites per field doses greater than the minimal effective dose show alternate zones of effectiveness and non effectiveness Finally, if there are from 45 to 50 per field no dose of immune serum so far used has been found effective The absolute number of trypanosomes per field necessary for the occurrence of zonal phenomena is constant for each single-cell strain, but varies with different strains Although the present series of experiments has not offered an adequate explanation of zonal phenomena they throw considerable doubt on various explanations which have been offered in bacteriological literature Thus, it is impossible to assume that the phenomonon is dependent upon inactivation because we have obtained it repeatedly with active as well as inactivated serum In the protective experiments with bacteria there is considerable evidence that even where a large dose of serum does not protect the animal, the serum actually kills the bacteria and the assumption is made that the animal dies as a result of the consequent liberation of endotoxins In our work, however, where a large dose of serum is ineffective the trypanosomes are not killed Recent investigators have postulated two substances in immune serum—one protective and the other antagonistic to the host's resistance and explained the ineffectiveness of large doses as due to the increased amount of antagonistic substance This is untenable because it would imply a point after which all larger doses would be non effective and would not explain the recurring zones found in our work. Finally, variability in the host's reaction can not be the basis because the phenomenon is directly dependent upon the number of trypanosomes present when the serum is injected. That the final explanation of the results both in bacteriological as well as trypanosome work will have to include the relation of the number of organisms present when the serum is given is indicated by the fact that the zonal phenomena in the protective action of antipneumococcus serum is also dependent upon the amount of virus injected with the serum. (Unpublished work of F A. Coventry.)

Concerning certain ecological methods of the Illinois Natural History Survey: S A. FORBES. It is the object of this paper to describe and illustrate by examples some of the uses of statistical ecology in determining relative frequencies of the several species of animals in the various ecological situations of an area which they inhabit, thus ascertaining the ecological preferences of species and their

organization in communities on the basis of an identity, or at least similarity, of such preferences By a comparison of these ecological preferences, in species so closely allied in classification as to suggest their relatively recent differentiation, some evidence is found of the existence of ecological barriers separating such species, and of the possibility of the influence of ecological segregation in promoting their specific differentiation. The Illinois distribution and ecological relations of three species of fishes are used as an example Ecological affiliations among the species of birds are shown by determining the numbers per square mile of each species found in each ecological situation of an area surveyed, and examples are given of the use of data so obtained in studying the movements of birds in complete or partial migration The northern flicker, the common crow and the prairie horned lark are used as examples of a partial seasonal redistribution of species which are classed as permanent residents in Illinois Finally, a more complex method is presented of distinguishing ecological communities, ascertaining their limits and evaluating the strengths of the affiliations of the several species of a community by determining for each pair of species a coefficient of association, based on the actual frequency of their joint occurrences in collections, the calculus of probabilities being used to distinguish joint occurrences attributable to random distribution from those due to ascertainable ecological causes. Through a comparison, tabulation and grouping of such coefficients, community relations are readily recognized, details of ecological relationship across definite community boundaries are made evident, and the intricate web of the relations of all the inhabitants of a complex area to their physical environment and through this to each other are disclosed

Influence of a power dam in modifying conditions affecting the migrations of the salmon HENRY B WARD (introduced by S A Forbes) The migration routes of the Pacific salmon are determined by external conditions which have been recognized in part at least. The streams which they frequent are peculiarly adapted for utilization as sources of water power The installation of high dams has modified natural conditions in ways affecting conspicuously the movements of the fish First of all the dam offers a physical obstacle to the movements of the fish, this has not been satisfactorily overcome by installations yet devised—other less evident changes are wrought in the environment The newly formed lake replaces a rapid, broken stream by a large body of still water The current which has exerted a directive influence is eliminated The water is less highly oxygenated —though in many cases not seriously changed Temperature conditions are most radically altered and apparently affect the movement of the salmon conspicuously.

Morphological changes in the nuclei of the subcuticula in the Acanthocephala H J VAN CLEAVE In tracing the embryological development in Pomphorhynchus, Hamann, in 1891, showed that the subcuticular nuclei are first recognized as giant spherical or ovoid bodies. Later in development these become progressively more amoeboid until finally each nucleus fragments into a large number of small rounded bodies scattered through the subcuticula of the adult Recently there have been frequent references to peculiarities in nuclei of adult acanthocephalans with no attempt at correlation observations on the different forms. On the basis of the subcuticular nuclei alone, the genera of Acanthocephala may be arranged in a phylogenetic series following the same progressive changes in nuclear form outlined in the ontogenetic series by Hamann In all members of the family Neoechinorhynchidae, the subcuticular nuclei of the adult are rounded giant nuclei, essentially like those of the larvae throughout the group In adults of the genera Pandosentis, Quadrigyrus and Leptorhynchoides there is progressive emphasis of the amoeboid tendency of these nuclei, culminating in Leptorhynchoides Many other genera, including Acanthocephalus, Echinorhynchus and Pomphorhynchus, enter the adult state with numerous small rounded nuclear masses scattered throughout the subcuticula.

The development of individuals from aggregated cells in Corymorpha C M CHILD (introduced by F. R. Lillie) In the course of work at the Scripps Institution, La Jolla, California, during the past summer the methods used by H V Wilson were applied to the large tubularian hydroid, *Corymorpha palma*. The naked stalk regions of these animals were ground with moist sand in a mortar, water was then added and the fluid strained through bolting cloth, 150 meshes to the inch. The somewhat milky fluid passing the cloth was then allowed to settle in tubes During the first two to three hours following dissociation aggregation of the cells and small cell masses into larger masses and sheets occurs rapidly, the surfaces adhering to each other when they come into contact, but the capacity for aggregation is gradually lost. All aggregates approach or attain spherical form and those 2 mm or more in diameter usually die, but smaller aggregates or pieces cut from the larger may live and give rise to new individuals or partial individuals in 4 to 5 days or more slowly The environmental differential to which the aggregate is exposed on the bottom of the container is a factor in determining the polarity of the new individual. The upper, freely exposed surface or some part of it tends to develop into the apical region and the region in contact with the bottom, into a more proximal level or a basal end. Aggregates frequently turned over and moved about develop basal ends less frequently than those allowed to remain undisturbed. That physiological polarity originates in a quantitative gradation in physiological activity or condition of protoplasm is shown by many lines of evidence for both animals and plants In the present case the environmental differential between the freely exposed region of the mass and that in contact with the bottom apparently serves to establish this gradation and so to determine the order of parts along the axis.

(To be continued)

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WHAT CAN THE MODERN CHEMIST LEARN FROM THE OLD ALCHEMY?[1]

IT was with very sincere pleasure that I accepted appointment to the non-resident lectureship in chemistry at Cornell for the coming term. I keenly appreciate the honor of the invitation, not only because it gives me opportunity of being a teacher in this famed university, but also, and even more, because of what I can here learn, for it is with us men of science from Europe as it was in the early days with the philosophers of old Greece, a Plato, or a Pythagoras: they journeyed as wise men to Egypt and returned as students of the wisdom of the Egyptian priests.

Indeed, to learn and to work in such an ideal laboratory as the Baker Laboratory of Chemistry is for every chemist, whether old or young, an actual joy. This monumental Temple of Science not only has the best equipment, but a master of the art, the head of the department of chemistry, has furnished it with light and air. A German once has said of the Chemical Laboratory in Munich: "In diesem Hause stinkt es sehr, Dies kommt von Adolf Baeyer her." The Baker Laboratory of Chemistry is exceptional in this regard, it is the most odorless laboratory of the world, it has *no* smell.

The subject which I have chosen for this introductory lecture is, "What can the modern chemist learn from the old alchemy?"

By some this question may be received with astonishment, while others may raise energetic protest. What? We modern chemists, the witnesses and workers of this "Age of Chemistry," can learn something from the old alchemy, full as it was of errors and fantasies! The daily press is constantly announcing the startling results of scientific research: "The riddles of the world are solved!" . "The proton has been isolated!" . . "Atoms have been decomposed!" . . "The chemical elements have been changed one into another!" . "The philosopher's stone has finally been found!" . . . "The transmutation of cheap elements into gold has been accomplished and patented," etc., etc. It almost seems as if we chemists were on the direct road to become God-like and all-powerful, but if we actually were so all-powerful, what would there be left for us to learn, and how could we control the enormous forces which we had developed?

[1] Introductory public lecture by Professor Paul Walden, of the University of Rostock, non-resident lecturer in chemistry at Cornell University.

In the days of the old alchemy there flourished in Italy a poet, Augurelli, who presented in 1518, in hexameter, to Pope Leo X, a work upon the "*Chrysopoeia*," or the true art of making gold As a reward the pope presented to this possessor of the Philosopher's Stone an empty purse, since to a man who possesses the secret, nothing is lacking except a purse in which to place and keep the artificially prepared metal The Past and the Present!

Let the past furnish us a warning against too much phantasy in modern chemistry

Let us examine with the magnifying glass of time the development of chemistry through separate characteristic periods of the past, in an attempt to see more clearly the relationship between the science of to-day and that of the "good old times" which have largely been forgotten In this glance backward, we will consider first the old chemists as men and as the so-called "Fathers of Chemistry" Second, the methods of work of the old chemists, experiment or sophistry. Third, the problems and the goal of the old chemistry, and fourth, the purification of matter then and to-day—the purity of matter as a fundamental problem of the chemistry of the future

I. *The Old Chemists as Men, and as the so-called "Fathers of Chemistry"*

Seven cities once claimed to be the birthplace of the renowned Homer But while place and time of this gifted poet's birth are veiled in obscurity, his name and writings endure And so is it with the origin and the name of chemistry. Think of the many terms which were applied to the science—Egyptian, Holy, Hermetic Art, Poiesis, Scientia Alchimiae, etc And yet the name *Chymea* means nothing further than cast metal, and Chymie, the art of casting metals [2]

Where was the birthplace of this Chymie? Who were its founders? Some ascribe its origin to Egypt, others to India and China, others, more recently, to Babylon and Assyria A fourth group of historians find the beginnings of the *science* in classic Hellas, while still others give to the Arabians the credit for the *practical* development of chemistry. And thus we see the mythical Hermes Trismegistos hailed as the seer of magic and chemistry, Empedocles as the father of the theory of the elements, Democritus as the originator of the atomic theory, Geber as the father of alchemy Paracelsus is honored as the father of iatrochemistry and Masson has recently bestowed upon Robert Boyle the comprehensive title, "The Father of Chemistry" [3] Some of you are also acquainted with the judgment of Wurtz[4]—"La chimie est une science française, elle fut constituée par Lavoisier," and toward the end of the nineteenth century Grimaux[5] stated, "Toute la science moderne n'est que le developpement de l'oeuvre de Lavoisier"

We will not seek to decide which of these pioneers is entitled to the greater credit or whether the striking advances in the beginning of our science are due jointly to Boyle with Becher and Glauber, or to Lavoisier with Stahl, or to Priestley, or Scheele, or to Cavendish Nor can the development of "toute la chimie moderne" be ascribed to a Dalton or an Avogadro, a Davy, a Berzelius or a Faraday. No single man is entitled to be called the "father of chemistry" And to those who seek to give this title to any single man the terse instruction in the Civil Code of Napoleon might be quoted, "La recherche de la paternité est interdite!" Let us not be so narrow-minded as to attempt to proclaim any one single man as the "father of chemistry," but rather let us regard the development of the science as the product of the combined intellects of the men of all times and of a universal search for the truth

Let us go back to the time of a Paracelsus and the beginning of iatro-chemistry Chemistry which up to that time had been primarily directed along metallurgical lines underwent decided change in character *Man* himself, and his diseases, became the chief subject of chemistry. The physician becomes chemist, and accordingly a benefactor of mankind. The knowledge of the iatro-chemist is sought in all countries and at all of the higher institutions of learning, such as Padua, Bologna, Paris and Montpellier, or Leyden, Basle, Prague, Wittenberg and Leipzig. Many incidents in the history of chemistry witness the noblest sort of competition, the highest degree of internationalism and political tolerance, as well as recognition of individual merit. Take the case of the famous French chemist, the demonstrator of chemistry at the *Jardin des Plantes* in Paris, Nicholas Lefebvre, who in 1664 was called to London to take charge of the laboratory of St. James; or that of Wilhelm Homberg (died 1715), successively German lawyer in Magdeburg, medical student in Padua and student of chemistry under Boyle in London, then doctor of medicine at Wittenberg, personal physician to the Duke of Orleans in Paris, finally becoming a noted chemist and a member of the Paris Academy, or Becher, who was successively professor of medicine at Mayence (1666), then director of the laboratory in Munich, member of the Chamber of Commerce in Vienna, in practice at Haarlem and at last in 1680 in England where he examined the Scottish lead mines and smelting works

[2] Diels, "Antike Technik," 2nd ed, 1920, page 124.

[3] Masson, "Three Centuries of Chemistry," London, 1925, page 574

[4] Wurtz, Histoire des doctrines chimiques, 1868.

[5] Grimaux, Lavoisier, Paris, 1896, page 128.

and in 1681–1682 visited Cornwall and studied the mines and smelting works . . . "here he suggested several improvements and ameliorations." (Thomson, *History of Chemistry*, Vol. I, p. 247, 1830.)

In the olden times a certain privileged freedom prevailed in the practice of the chemical and medico-chemical callings. Knowledge opened the doors to all classes of European culture of that time. This knowledge flowed through the whole world like a liquid. It created a spiritual unity among scholars and paved the way for mutual understanding among the nations and a joint cultural development. Consequently the practical chemist and medical chemist of whatever nation became an international carrier of culture and an apostle of peace.

What about to-day? Must it be so altogether different? If I may be permitted to express my opinion with reference to the creation of the Non-Resident Lectureship here at Cornell, it is this. The value of such an arrangement lies not alone in the scientific and pedagogic activity of the temporary incumbents in their special fields, but further than that, it serves to renew these old and highly ethical forms of reciprocal contacts between scientists in order to create a mutual spiritual atmosphere, and to pave the way for a peaceful cultural development of mankind. From this point of view the step taken by Cornell University may be regarded as historically significant. By this action the great traditions of science become alive again, and we are all moved by the spirit which led Humphry Davy to state publicly one hundred years ago, "Science, like that nature to which it belongs, is neither limited by time nor space, it belongs to the world and is of no country and no age."

II. *The Working Principles of the Old Chemists. Experiment or Sophistry?*

Thou, youthful seeker after knowledge, investigate and experiment and never desist therefrom, for thou willst harvest fruits a thousand fold. (Geber)

These were the words of the famous Arabic encyclopedist of the old chemistry, the mythical Geber, some seven hundred years ago. "Labora, Ora et—invenies" . . . did the "adepts" in the monastic cells call out in the middle ages. From among the ranks of the iatro-chemists, we are cautioned at the beginning of the seventeenth century (Crollius, *Basilica Chymica*, 1629), "Alchemy is not attained without work" (that is, experiment).

It is a fact that this uninterrupted work, this indefatigable research has broadened and deepened chemical knowledge. "Desist not therefrom, for thou willst harvest fruits a thousand-fold," so spoke the experienced practician Geber. Are we not struck with awe upon consideration of this old experimental art, which after centuries of endeavor finally succeeded in preparing hydrochloric acid from salt and clay, nitric acid from saltpeter and clay, sulphuric acid from calcined vitriol or alum, and were able with these acids to obtain the key to analysis and synthesis? Think how long these experimental methods took, as compared with the methods of preparation employed in our modern procedure. Only experiment brought the thousand-fold fruits. Very often the latter were not even anticipated by the investigator. They came accidentally. We can, therefore, understand the lesson which Liebig, famous both as a discoverer and experimental artist, gave a hundred years ago. "If one works, one is pretty certain to make discoveries, it makes no difference where one begins."

Any scientific work may lead to a discovery. A pregnant thought. More remarkable, however, are oftentimes the conditions, in particular the mental conditions, under which such a task proceeds. Let us take, for instance, such a divinely gifted discoverer as Sir Humphry Davy (1778–1829). After he had attained world fame, in 1807, by his discovery of alkali electrolysis, it was necessary for him to appear in society more often than he wished. Despite this, he always went to his laboratory after he had returned to his home, where he continued to work until three or four o'clock in the morning. His biography states . . . "His greatest lack was that of time. He was forced to hurry . . . he would put on clean clothes without removing the soiled ones . . . at times he would have on as many as five shirts and several pairs of socks over one another. He would often arouse astonishment among his friends with the speed at which his corpulence increased and decreased" (Paris). One has often said jokingly that Davy's greatest discovery was Faraday. Faraday, a man who was seldom congenial, wrote of his works (1845), "I am so engrossed in discoveries that I have barely time enough to eat."

There is another, in whom literature and science in unique combination led to great results. Goethe, the famous poet, creator of Faust, was also a great natural scientist. After he had discovered the middle jaw bone in man, *Os intermaxillare*, in 1784, he wrote in a letter, "It has become a delightful avocation for me; I have made an important and pretty anatomical discovery, and I am so happy that my internal organs dance."

Here Goethe has succinctly revealed the psychological principles of work and discovery. It is the joy in the progress in the work which raises one to a high emotional pitch, a rare feeling of happiness; his spiritual exaltation stimulates his physical power, and causes the investigator-discoverer to forget all the

usual necessities of the body This joyful feeling has been experienced by everyone after he has recognized or made certain of a new scientific truth as the result of experiment It is not the momentary practical value that calls forth the feeling of happiness, but the knowledge that the great Creator and Ruler of the world has revealed to us something which has heretofore been hidden

One often hears the question Has this or that scientific observation or discovery any value or use? The history of the development of science and culture has invariably shown that value or use are only relative terms, and are in only partial dependence upon time, place and culture. The answer which the great Benjamin Franklin once gave still holds good to-day One asked concerning the value of discovery His answer, as you know, was "What is the use of a child? It may become a man!"

Thus far I have depicted experiment as the basis for chemical knowledge and advances in chemistry It is indeed an enlightening fact, perhaps decidedly so at present, to note how in the olden times words of caution were continually expressed condemning the metaphysical and philosophical *method* in *chemistry*

Even Geber about the year 1200 deemed it necessary to advise warningly "The beginner in science should not despair If he is looking for knowledge he will find it, however not by the study of books but by investigation of nature" (Geber, *Summa perfectionis*, Chap 100). Not the study of the works of the Greek and Alexandrian philosophers and pseudo-alchemists, but a direct experimental study of nature itself.

Does it not strike us as somewhat peculiar when in the year 1600 Crollius (*Basilica Chymica*) again differentiates between two types of chemistry and again speaks with words of warning

"Alchemy is of two kinds, namely, the natural, greatly honored by the children of the art, and, on the other hand, the sophistica or false, greatly despised by these . . Consequently, in this subject no one should believe more than that which experience teaches"

Hundreds of years sank away in the sea of eternity. Then did the great Berzelius say at the beginning of the nineteenth century, "chemistry is 99 per cent. manual labor and practice (that is, an art attained by work) and only 1 per cent. theory." Despite this statement, Justus Liebig, then a student, was obliged to listen to a chemical natural philosophy rather than chemistry About 1840, Liebig criticized this metaphysical era in natural sciences and chemistry by the statement: "The activity and influence of the natural philosophers up to this time was the scourge, the black death of the century," and especially was this true in chemistry. Does not such a statement as that of the natural philosopher, Carus, to the effect that, "the diamond is a pebble which has come to consciousness," sound somewhat strange to our ears? It was the opinion of K. W. G Kastner (1806) "that iron in combination with hydrogen goes over to carbon," or conversely that "carbon appears as iron upon loss of all hydrogen."

To-day we should regard these chemical definitions as absurd That these were even acceptable one hundred years ago gives us food for thought, particularly if we examine with a critical eye some of our own modern views. For scientific fads and errors are seen to recur periodically in the development of the science

The very fact that leading investigators and naturalists had found it necessary to issue warnings from time to time demonstrates the recurrent ascendency of the metaphysical line of thought We can, therefore, understand why, toward the end of the nineteenth century, Helmholtz recommended to those pursuing the natural sciences "the strict discipline of the inductive method, a faithful adherence to the facts which made the natural sciences great", why he praised those who were attempting to "remove from the natural sciences all metaphysical frauds and arbitrary hypothesis," and those who were attempting to "make the natural science a more definite and exact expression of the laws governing the facts"

III. *Aims and Tasks of the Old Chemistry*

In medieval times one spoke of chemistry as a "divine" or wonderful *art* Divine—"because the works of God are of two kinds The work or course of nature comprises Philosophia, The works and ways of Christ, Theology. In the practice of both of these should all mortals spend their earthly existence." (O. Crollius, *Basilica Chymica*, 1629, p. 71) Paracelsus taught that "Alchemy is the completion of all nature—and that the stomach is the true alchemist," and, that "medicine rested on four pillars, Philosophia, Alchymia, Astronomia and Physica." Without these one could not begin the work of "preparation, separation and true analysis" or "the solution of natural things" (*l.c*, p 58). One sees therefore that a great philosophical *Art*, a wide and diversified *knowledge* including all of nature, and a thorough practical *ability* which must be acquired by constant practice, are required.

How and for what purpose shall this divine art be used? Crollius (*l.c*, p. 247) gives the following answer, "With heartfelt invocation of God and thankful soul this art is to be used for the glory and praise of their Creator, for the benefit of their needy fellowmen, and for the honor of this art, Amen."

We can learn much from this three-century old

characterization of chemistry. The purposes and activities of chemistry were not in those days limited to mere technical knowledge. Chemistry was altogether a study and knowledge of nature; its application was service to mankind, in the name and to the glory of God, as the Creator and guide of nature and of the world. The old chemists were imbued with the idea of a kind of divine service or *idyllic* research, and a feeling of security with God.

I made the remark just now that an idealistic searching imbued the old chemists. Many fundamental writings were credited to the old monk, Basilius Valentinus. Is it not remarkable and characteristic of the sixteenth century and the people living at that time, that this monk never lived, and consequently did not himself write these volumes, but that the actual learned author has hidden his identity under this pseudonym?

Does it not make us modern chemists and narrow specialists somewhat retrospective when these, so often misunderstood and ridiculed chemists, so-called alchemists and iatro-chemists, are depicted as veritable *romanticists, idealists and moralists*. Should we not glean some teachings for our own spiritual guidance from these far past times? Has it not unfortunately become a fact that in our research we have practically lost all connection with nature; that our chemistry is no longer a "natural science", that it no longer represents a knowledge of nature as a whole, but that it threatens to resolve itself into a host of individual sciences?

Even to-day, looking back but a few years, we can hardly conceive how Joseph Black (1728–1799) could be at the same time a physician, physicist and a great chemist, or how the romanticist of science, Joseph Priestley (1733–1804) could be a theologian, linguist, physicist and a chemical discoverer *par excellence*, or how Jacob Berzelius (1779–1848), physician, could at the same time be a pioneer in mineralogy and a world leader in chemistry, how he could master the applied, analytical, physiological, inorganic, organic and theoretical branches of chemistry in classical style, and how he could unify chemically dead and living nature in its connections and behavior . . . Is it not true that we have become rich, yes very rich, in details, but poorer in "natural science"? Have we not cause for serious concern over the future development of a chemistry, so productive in individual facts, but so unsatisfactory from the point of view of the great ideas in a world of dead and living matter?

Biochemical Aims of the Old Chemists

"La chymie est imitatrice et rivale de la nature, son objet est presque aussi étendu que celui de la nature même; cette partie de la physique est entre les autres ce que la Poësie est entre les autres genres de littérature." Diderot. (Chemistry is the imitator and rival of nature. Its field is almost as wide as that of nature itself; its relation to physics is as that of poetry to the other forms of literature.)

This proud and frequently quoted passage originated amongst the French encyclopedists at the time when the mechanistic view of life in De la Mettrie's "L'homme machine" and in Holbachs' "Système de la Nature" (1770) found its expression.

However, this goal was recognized as that of chemistry many centuries before! Let me quote from several places in an old book.[6]

In order to imitate natural processes "Time, mass and weight . . . are necessary." The alchemists say that they "reverse the orderly processes of nature with their highly developed art, and that they can revert all matter to the *materia prima*." They, the goldmakers, boasted still further that they, by their art, excel nature, for not only can they restore to life things which have died, but they can also give life and soul to the inanimate, something which nature had not done either because she was not able or did not wish to do so." (p. 38.) Again they claim that "human beings and other living animals can be created in the laboratory with flesh, bone and senses, and can be given a soul," and that they "can generate trees and plants without their natural seeds" (p. 44), that "burned or carbonized wood as well as metallic ashes, which have gone through the smelting fire, can be made to grow, foliate and bear fruit." (p. 43.) This "divine and supernatural art can create power and riches at will. It restores health to the sickly." Concerning those who have reached the senile age, "it transforms the old man into a youth, stronger and more handsome than he originally was." Finally, those who have almost passed into the beyond can, by its power, again regain the strength to live. The preparation in question is called by the alchemists sometimes "quintessence," again "Philosopher's stone," or "potable gold."

Biringuccio thus portrayed the supreme aim of chemistry or alchemy. At what time was the omnipotence of chemistry so heralded? When did this earlier "Age of Chemistry" exist? In the year 1540! Even then the fundamental premises of chemical work were:—time, mass and weight, as well as reversibility

[6] Biringuccio, *Pirotechnia*. Vannoccio Biringuccio (1480–1538) was a famous builder and metal worker of his time in Rome and Florence. His book "Pirotechnia" is a classical text-book of industrial chemistry. It appeared in Venice in 1540 and recently has been translated by Dr. O. Johannsen, 1925, Braunschweig, Vieweg and Son.

of chemical reactions. How similar are the ideals of the past and our present! The *generatio aequivoca* or spontaneous generation, the palingenesis or the regeneration of the dead matter, the question of Homunculus and the rejuvenation of mankind, etc, are these not problems of our own times?

Truly does not Biringuccio speak concerning these problems of the alchemists when he says, "if the claims were really justified, they should not have given their art the name, alchemy, which it now bears, for they could have said that they have God, the creator of all things, locked in a flask."

May I now be permitted to make an excursion into the field of modern medicinal remedies? You all know the meaning of sunlight therapy You also know the part played in medicine by mineral salts as foods, and as blood and nerve tonics. You have surely heard of the recent curative methods involving the use of acids (acid therapy) some inorganic, others organic Diseases of the respiratory system, etc., are cured by them. But even dermatology, neurology, ophthalmology, etc, employ substances of this sort. All of these are important problems of modern medicinal science But why do I mention these things here? Simply to show that for such cases the old chemists, alchemists and iatro-chemists could well be our teachers, were we to study the past of chemistry more thoroughly Consider the times three centuries ago It is a proud maxim which held sway at that time

> "In sale et sole existunt omnia."
> (Life depends on salts and sunshine.)

Oswald Crollius,[7] in Wittenberg, recognized as the most influential disciple of Paracelsus, writes in his book *"Basilica Chymica"* (Frankfurt, 1629).

"Not without cause do the ancients say that everything is contained in the sun and in salts" (*l.c.,* p 184) From this quotation it naturally follows that special powers were ascribed to those acids obtained from sodium chloride or other salts by distillation with clay Among these were spiritus salis (hydrochloric acid), spiritus salis nitri (red nitric acid containing oxides of nitrogen) On the basis of the experience of Paracelsus, Crollius (*l.c*, p. 145) recommends the spiritus salis for about twenty diseases both internal and external Rudolf Glauber, known as an industrial chemist, greatly extended (1650) the list, requiring some five large pages to enumerate all the diseases for which hydrochloric acid in various doses acted as a curative. That was three centuries ago. To-day we state it in another manner and say that the hydrogen ions are vital. "All living nature is regulated by the hydrogen ion concentration Health and sickness, life and death, are ruled by it," says Arrhenius ("Chemistry and Modern Life," Leipzig (1922, p 280)).

The Transmutation of Metals

Even though Geber, in the 12th and 13th centuries, describes and praises the refinement of metals (Liber de investigatione perfectionis), he differentiates between *imperfection* and *perfection* The way to go from the first to the second is the "praeparatio" He says "Preparation involves the removal of the superfluous, and the addition of whatever is lacking to bring perfection to an imperfect body" (*l.c*, Chapt. 2). . "This can only be accomplished by application of specially adapted methods and the use of purifying agents" . "Experience has guided us to various working processes, such as calcination, sublimation, descension, solution, distillation, coagulation and fixation" (*l c*, Chapt. III.) The substances which have been found to be useful in this preparative work include "all sorts of salts, alums, vitriols, as well as glass, borax and related substances, very sharp vinegar and fire" (*l c.,* Chapt. IV). These are the experimental principles of alchemy Are these not also the principles which have contributed to the origin and development of our present-day chemical knowledge? Are not the old working methods of seven hundred years ago still employed to-day? And is not the purpose of these operations, these preparative methods, namely, that of the purification of materials, scientifically *correct?* Are not both Analysis and Synthesis represented in this ancient methodology? Are we then not heirs, imitators and developers of these past ages?

We have too often ridiculed and misunderstood the alchemists. Justus von Liebig,[8] was right when he said, "Alchemy has never been anything else than chemistry. It has been done a great injustice by confusing it so constantly with the gold-making arts of the 16th and 17th centuries. Alchemy was *a science,* and it included also all branches of the technical-chemical industry."

Besides the old rules for the refinement of metals by purification, which I have just given, the important chapter on the *transformation of metals* is still intact in the old chemistry. Let me point out incidentally that the theoretical or metaphysical basis for the

[7] Oswald Crollius (died 1609) was an outstanding physician (iatro-chemist) who knew what fulminating gold was. He introduced the preparation and the terminology "hornsilver" (luna cornea) for silver chloride, and first prepared tartarus vitriolatus, potassium sulphate, from potassium carbonate and sulphuric acid.

[8] Chemische Briefe, 3rd letter.

"possibility" of such a transmutation is founded in Aristotle's philosophy, namely, in the original substance, *prima materia*. We are, however, primarily interested in another side of this subject "transmutation." Were there any facts which would have led then in olden times to conclude that in chemical operations with the metals lead, copper, mercury, silver and gold, such a transformation had taken place? Or, to put it differently, was it not necessary to assume from certain very definite facts that a complete transformation of most metals into gold had taken place, when one considers the status of the chemical methods for separation and preparation of that time?

Again, did the experienced metallurgists and practical chemists of that day really believe in transmutation? The latter question is truly important, the more so, since it has usually been disregarded altogether in passing judgment on the idea of transmutation

Let me answer immediately and in the *negative* The real authorities on metallurgical chemistry gave no credence to the possibility of artificial preparation of gold. Two practical chemists may be quoted as witnesses One is Biringuccio. In his classical work "Pirotechnia," written at the beginning of the 16th century, he not only disavows all possibility of artificial preparation of gold, but he adds, "I would have to regard people as very clever, a sort of terrestrial angels, were I to believe that they could accomplish this." Even though the other witness, the outstanding practitioner, Rudolf Glauber, defended the transmutation idea, he nevertheless writes "I will not seek to prove, nor could I do so, that he (Paracelsus) made gold and silver in large quantities . I wish only to indicate that it might be possible to do so How to do so on a large scale I do not know at present, nor am I particularly interested to know" (*Opera Chymica*, I, p. 369, 1658). From this indirect statement we can plainly see that to him transmutation was regarded as *hypothetically* possible, but that practically he had never actually accomplished it and did not regard it as important For he says in evident disdain of his theoretical proofs, "nor am I particularly interested to know."

But to return to the other question Were there any reasons which, to a slight degree at least, made it necessary to assume that a *transformation to* gold had taken place? This question can be answered in the affirmative. We may regard among such facts the finding *of smaller* or *larger traces* of gold during the course of the ordinary metallurgical processes, a fact which was emphasized again and again Even the great alchemistical scientist, Albertus Magnus (1193–1280) teaches that gold is found in all minerals. Three hundred years later Biringuccio, whom we have already quoted, writes "there are few metals which do not contain a trace of gold, some more, some less." Glauber even suggests the *reagents themselves* as a source of gold in chemical processes. He obtained gold as a residue after he had dissolved fine silver in aqua fortis, precipitated it with salt water, washed, melted and reduced it to silver, remelted it and then dissolved it again in aqua fortis. Then he inquires, "Where did this gold come from? From the silver, the aqua fortis, or the salt water, the three substances which were used in the reaction?" It was his belief "that the spiritus nitri had carried over some gold which was present in the iron or copper vitriol used in the distillation." (Glauber, *Opera Chymica, I*, p 112, 1658) Is not the negative attitude with reference to the sudden appearance of gold in pure silver a remarkable thing about this argument? What could be more logical than for Glauber to assume that a transmutation had taken place, that is, that gold had come into existence? Glauber regards this question or the "possibility" as so improbable that he does not even mention it, but proceeds in a critical experimental way to examine the reagents used in solution and precipitation to ascertain whether they contained gold. The crude nitric acid, prepared by the distillation of saltpeter and vitriol, he regarded as the probable source of the traces of gold found later in the silver, the particles of gold being carried over from the vitriol during the process of distillation

Two things can be learned from that which has just been presented, first, that the occurrence of small traces of gold in minerals was recognized many hundreds of years ago, secondly, that the elimination and separation of these minute quantities of gold is accomplished with great difficulty, so that gold that was found in the product of a chemical reaction might be mistakenly thought to have been formed in the process. Glauber's insight must be regarded as truly remarkable, and his statement shows that the clever investigators of long ago knew that the gold was not created in the experiment.

Even if these men, learned in their art and in the knowledge of minerals, did not regard the sudden appearance of traces of gold as transmutation, and did not ascribe its origin to other metals, but traced back its source in classical nineteenth century style to minute quantities present in the reagents or apparatus, the theorists were of an altogether different opinion. Their greatest authority, Aristotle, held that metals were formed from the "original substance" and believed in the growth of metals in the earth and from vapors. The alchemists therefore argued that gold could come into existence during chemical processes. For, they added, did not one actually find it in all metals and minerals?

We must admit that we have come to a critical point in our chemical philosophy. Two opposing views are here met with. As long as we adhere to the conception of an element and regard its stability as a law, the transmutation idea will have no place in chemistry. Conversely, as soon as this conception of an element begins to totter, the idea of transmutation will gain in strength. It has been so in the past and is so to-day. Let me speak briefly concerning the future.

What is our attitude and our scientific belief with regard to the transformation of base metals into gold? How long ago was it when, on the basis of our modern theories, the prophecy was made: "If by some agency or other we could only cause mercury to expel an alpha particle (that is, a positively charged helium atom) and a beta particle (a negative electron), the product would be an isotope of gold" (F. Soddy, 1913). Since then (1913) this statement has been often repeated, unfortunately too often, not only by scientists, but also by the press. As a dogma it has already brought confusion in the minds of the laity, and as a new principle it has served the group of contemporary alchemists and pseudo-chemists to resurrect the old idea of transmutation. Are not statements such as the following often made in popular magazines? "The philosopher's stone has been found"—"The dream of the ancient alchemists has been made a reality by modern science." As you know, this idea has reacted upon modern science, but certainly not to the benefit of modern exact research. The much-disputed question concerning the transmutation of mercury into gold, which Miethe claims to have accomplished, has involved, since 1924, not only a whole group of chemists, both theoretical and experimental, but also business-like speculators. And what has been the result? Unfortunately the witty chemist is right in saying, "the gold of Miethe will probably be found to be the gold of the myth." As before, the old way of making gold (earning money) will be the simpler, less expensive and most dependable.

This suggestion by Soddy gives us a picture of how gold might be formed by the degradation of an element of higher atomic number and greater atomic weight. If mercury, which has an atomic weight of 201, can be robbed of an alpha particle which has a weight of 4, the remaining substance would have a weight of 197 and this is the weight of gold. To-day such a suggestion seems scientific to us. But was not the suggestion of Boerhaave brought forward two hundred years ago just as scientific? Silver in his day was represented by the symbol ☽, a corrosive (an acid) by +, gold by ☉, and mercury by the symbol ☿. An old English statement (Boerhaave, *New Method of Chemistry*, 1727) runs as follows: "Quicksilver evidently shows gold in the middle or body of it, silver at the top or in the face and a corrosive at the bottom, accordingly all adepts say of mercury that it is gold at heart, whence its heaviness, that its outside is silver, whence its color. . . And hence that maxim upon mercury. Strip me of my clothes, and turn me inside out, and all the secrets of the world will come forth." There is much food for thought in these words. Is it not peculiar that, just as to-day, mercury played the rôle of mother substance for the artificial preparation of gold? Does not this old symbol of transmutation greatly resemble the modern one? There "the heaviness at heart," here the atomic mass at the center; there the visible properties ("white color") on the outside, here the outer electrons. Does not the one say "Strip me of my clothes," while the other says "remove an alpha and a beta particle"? And do not the two symbols resemble each other furthermore in view of the fact that they have remained nothing but symbols in spite of all experimental efforts? The mode of expression of Boerhaave might well here be used. Not the "clothes" but the "whole skin" would have to be removed!

Let us forget for a few minutes our modern views as scientific aids of a given era. Let us regard as analytical chemists, without any theory, the observations during the bombardment of mercury by electrons and the varying traces of gold coming to light during this treatment. Would it not be more logical to assume that mercury, despite all purification, was still contaminated with minute quantities of gold? If the old chemists were able to detect weighable quantities of impurities, such as a grain of gold by purely chemical means, may not the charge of the electrons be the physical aid, assisting in the separation of the last traces of gold in mercury, and the isolation of quantities to the order of 10^{-8} to 10^{-9} grams? It seems to me that the difference between the past and present lies in the order of magnitude of the applied energy and amount of the impurities which have been separated.

That brings us to the problem of the "*purity of our materials.*" It is a peculiar and striking characteristic of the older alchemists that they seemed to show no curiosity concerning many substances which they observed in the course of their experiments, and made no attempts to investigate them. Thus we find that these old chemists had seen and described the oxides of nitrogen more than seven hundred years ago, had used chlorine in their aqua regia, had obtained sulphur dioxide directly by burning sulphur in air, knew of the formation of hydrogen from iron and sulphuric acid and of its explosibility—yet all these things had to be discovered, that is, identified, recognized and differentiated chemically at the end of the eighteenth century!

IV. *The Problem of "Pure Substances"*

A Berlin physicist, Peter Riess (died in 1883), known for his work in frictional electricity, defines chemistry as the "impure part of physics." Let us assume that such was the relationship between chemistry and physics 75 years ago. The question naturally follows whether the methods or the materials could correctly have been labelled "impure." If we frankly investigate this question, we will find that his charge is justified. Indeed, the problems of purity and methods of purification are of fundamental importance to both pure and applied chemistry. The gradual progressive expansion of qualitative reactions and methods of separation of the individual metallic and gaseous substances did not reach its development until the eighteenth century. Particularly well worked out were the wet analytical methods which soon caused the enrichment of chemistry by 15 new elements. Further differentiation of substances which had heretofore been regarded as homogeneous, by electrochemical and spectroscopic methods in the nineteenth century, is generally known. It is probably not known how many countless substances, now recognized as elemental by every beginner, were regarded as compounds, or how substances later proven to be compounds were considered to be elements. Take the case of uranium, and its oxide, which for fifty years was thought to be the element, or that of titanium nitride, TiN, which was thought to be the free metal.

According to Davy the diamond contained oxygen, phosphorus and sulphur were compounds containing these elements together with oxygen and hydrogen. Berzelius defended the opinion that chlorine contained an element "murium." Nitrogen was a compound according to Davy, and even as late as 1825 Berzelius contended that nitrogen was the suboxide of an element "nitricum." The metals potassium and sodium discovered by Davy were considered by Gay-Lussac and Thenard as compounds of the metal with hydrogen (1808).

If we inquire as to the causes of these erroneous conceptions, the answer is not difficult to find: the undeveloped state of the methods for separation and purification; in other words, the presence of impurities.

If we survey the present, and examine carefully the modern views concerning the nature of the various elements, we will find much in common between the newer and older ideas. The compound nature of the elements was even then a subject for speculation and one which had been repeatedly tested by experiment. The old idea of hydrogen, as a component of all matter, is again accepted in the form of the proton.

Many of our other most modern conceptions find their predecessors in the past. We have already mentioned the fact that Berzelius regarded nitrogen as a compound substance and defended his views very skillfully. That it should be nitrogen, which after just one hundred years should have partially been broken down by Rutherford by bombardment with alpha rays, is a unique phenomenon in the progressive development of our views.

According to Einstein's theory of relativity, a transformation of mass into energy is possible. It has often been said that such a change, as in the case of one atom of nitrogen, would be accompanied by the evolution of an immense quantity of heat which could become economically valuable. According to the well-known Einstein equation, $E = mc^2$ (where E = energy, m = mass, c = speed of light), a quantity of heat equivalent to that obtained by the combustion of 3,000 tons of coal would be obtained by the destruction of one gram of any substance.

More than one hundred years ago Lichtenberg, professor of physics at the University of Göttingen, made the following statement: "If one could only invent some suitable substance to decompose the nitrogen of the air in order to set free its heat, it would be one of the greatest discoveries of economic importance." The reversal of the Einstein equation permits the transformation of energy into mass ($m = E/c^2$). The modern successors of the old alchemists, the hyperchemists and Theosophists, could well maintain from their point of view that this transformation or materialization of energy has long been known to them. It is reported in all earnestness that in the year 1666, at The Hague, in presence of the physician Helvetius, gold made artificially from lead actually gained in weight. Another report concerning an incident in Vienna (1716) states that in the transmutation of copper pennies to silver, there was obtained 125 pounds of silver from 100 pounds of copper.

Concerning the question of the transformation of energy back into matter we can also quote Glauber from his treatise on "*De Auro Potabili*."[9] "It is believable that if we knew a suitable container, we could catch and coagulate in it the rays of the sun as well as the heat from ordinary fire, and thus metals could just as easily be generated on the earth as in the earth." But let us return to our consideration of the historical rôle played in chemistry by "traces" or "impurities." A special volume might be written concerning this influence in the development of chemistry. Think of the part played by catalysts in chemical industry. Consider the vitamins and the most recent experiments of Windaus in physiological chemistry. We will limit ourselves to a few such examples.

Material perception and abstract classification fol-

[9] *Opera Chymica*, II, 328, 1659.

low each other only after long periods of time Besides the kind of matter the quantity of matter is important in the history of this development With advanced analytical-chemical procedure, the smallest traces such as accidental, subordinate and minute quantities of a foreign body become sources for the discovery of new elements. Modern industry has learned to value and accumulate these "traces," and to transform them into appreciable quantities Take the case of tungsten, titanium, selenium, thorium, uranium, radium, helium, germanium, etc At the same time, this change in practical value of what were once impurities has served to develop the method and sensitivity of their detection and recognition Thus gold can now be detected in quantities as small as $10^{-8}-10^{-9}$ grams; helium in amounts as small as 10^{-9} cc (Paneth, 1926), one part of mercury in 1½ million parts of coal tar (Kirby, 1927) and iodine in amounts as minute as 10^{-6} grams can be discovered if present in the soil, plants, meteorites and iron ore, yes, even in steel itself (Fellenberg and Lunde, 1927).

We become contemplative when we find, on the other hand, that even in our purest preparations, using the utmost precautions, such "traces" are still detectable. Let us recall the gold from mercury (Miethe) and the formation of helium from tungsten (Wendt and Irion, 1922) Let us not forget the discovery that quartz vessels hold gases very tenaciously, even after heating for many hours above 1000° C. and being thoroughly exhausted with a pump (W. Biltz and H. Müller, 1927) You all know of the remarkable observations of F. Paneth and his coworkers in 1926–1927, which seemed to indicate the transmutation of hydrogen into helium, with the aid of finely divided palladium More thorough investigation showed, however, that the asbestos which was used in the apparatus contained helium. Countless other examples could be cited

We thus see how experimental difficulties which are barely surmountable confront us in the case of such simple and stable substances as the elements The term "purity" can be applied only to an ideal state, in that this condition is approached asymptotically with our experimental technique as it is at present. What then are we to expect in regard to the purity of compounds, organic and inorganic substances of highly complex nature and by no means stable? How simple—*sit venia verbo*—rather how primitive, are still our customary qualitative tests for purity in this field! One could almost say that we of to-day are scarcely further advanced in the testing of the purity or individuality of complicated compounds than were the old chemists in the testing of the purity of metals However, the problem of pure, or we may say "ultra-pure" substances has yet other important phases.

As long as we are satisfied to be able to detect the presence of these previously mentioned "traces" of foreign substances in our purest materials, we stand on the firm ground of experimental analytical chemistry Berzelius held that chemistry consisted of 99 per cent. experiment and one per cent theory And we have reason to be proud of being able to detect such a small amount of a gas as 10^{-9} cc, which, in simple illustration, would mean that if this laboratory were a single large box full of air, and we liberated a thimbleful of a rare gas in the building and mixed it thoroughly with the air, we could then detect that gas in a sample of air taken anywhere in the building But in some cases our modern methods of reasoning suggest an "explanation" for the presence of these minute quantities of matter we say that they have come into existence by transelementation Is it not peculiar and psychologically interesting that we, with all our logic and weighty experience, should capitulate so quickly to this new idea? In what other branch of chemistry would we so readily accept so radical a theory? Have we not returned to the reasoning and evidence of the alchemists and those who believed in transmutation, and who believed in transmutation because they wished it?

We are witnesses to-day of a tendency in research against which warnings were once issued. It was Crollius (1629) who three centuries ago pointed out the danger of the "*Sophistica*" or false chemical art. Helmholtz earnestly recommended thirty years ago a cleansing of the natural sciences of all metaphysical, fraudulent deductions The scientific study of minutest quantities is actually just as characteristic of the present day as is our development of large scale processes in the industries. If we consider the lessons of the past, and take as our guide the natural causes for the occurrence of these minute quantities, are we not justified in asking this question:—Has the so-called destruction of the atom into unweighable quantities of protons and traces of helium, with total exclusion of impurities from the materials and the apparatus, been realized and can it be realized?

In addition to these metaphysical deductions and theoretical conclusions, whose greatest importance is inversely proportional to the smallest traces, there are other questions for the experimental chemist. For example—What are the chemical properties of the "ultra-pure" elements and compounds? In what physical state and in what chemical combination do traces of substances exist, such as gold in mercury, iodine in steel, gas on the surface of quartz, etc? So we pass from the past with its teachings to the future when we say—In addition to our present chemistry a

future chemistry or "ultra-pure" substances must arise: not only the physical condition but also the reactions of these "ultra-pure" substances must be investigated. How do these substances react on one another and also in great dilution when present only in traces? Is it not peculiar that matter in the "ultra-pure" state behaves very much like the so-called "unsaturated compounds" as is shown in the behavior of ultra-pure water, the Baker extremely dry bodies, etc ?

And this brings us to the end of our discussion Can we and should we learn something from the old chemistry, from its masters, its methodology and its aims? I think the answer is "Yes" An individualistic rhythm controls the development of chemistry. People and times change, yet certain ideas and ideals persist forever True enough they undergo a change in form and value with the course of time, but they live on from generation to generation and act as guides for chemical reasoning and research

Pascal's words will ever remain true —"La suite des hommes pendant le cours de tant des siècles doit être considéré comme un même homme qui subsiste toujours et qui apprend continuellement." (The succession of men during the course of many centuries should be considered as one and the same man who exists always and learns continuously)

PAUL WALDEN

CORNELL UNIVERSITY

SARAH FRANCES WHITING

AFTER a life characterized by devotion to high ideals and filled with unusual activities, Sarah Frances Whiting, professor emeritus of physics and astronomy at Wellesley College, died on September 12, 1927, at her home in Wilbraham, Massachusetts. She retired in 1916 after forty years of service at Wellesley

She was born at Wyoming, New York, in 1846 Through her paternal grandmother she was a direct descendant in the ninth generation from Elder Brewster of the *Mayflower*. Her father, the principal of a series of academies which preceded the New York public schools, was not only an excellent classical scholar, but was also well versed in the science of his day. After graduating from Ingham University in Le Roy, New York, Miss Whiting was a teacher there and in Brooklyn for about ten years.

In 1875, when Wellesley College opened its doors to students, Edward C. Pickering, then professor of physics at the Massachusetts Institute of Technology, had established the first students' physical laboratory in America. Mr. Durant, the brilliant founder of Wellesley College, ever alert for new methods of teaching, was greatly attracted by the reports of the students' experiments. He conceived the idea of duplicating the method at his college, but was seriously handicapped because his faculty was to be composed entirely of women. No woman trained in physical experiments could be found, and in no college was such training offered.

Mr Durant then inquired of Professor Pickering whether it would be possible for him to allow such an appointee to sit as a guest in his classes, since women were not then admitted as regular students. With his wonted courtesy, Professor Pickering agreed and offered to assist in any way towards establishing such a department at Wellesley.

Mr. Durant's quest for the holder of his chair of physics ended when he found Miss Whiting at the Brooklyn Heights Seminary, where, although teaching mathematics and the classics, she had already become fascinated, as she said, with physics and the revelations of the spectroscope

She went to Wellesley in 1876 to plan and equip the new department of physics Four times a week in that busy year she sat as a guest in Professor Pickering's classes, and learned from him of his "physical manipulation" Not only did she have to acquire facility in using the instruments, but it rested with her to decide upon those to be purchased for Wellesley, a perplexing problem in those days when all such instruments were made abroad by firms who did not issue catalogues

She was therefore obliged to visit the physical laboratories of various colleges and institutes, such as Harvard, Yale, Amherst, Bowdoin, Pennsylvania, and see the instruments before ordering She was always courteously received, although in those early days when the whole idea of a woman's college was so new, there must have been among the staid professors many a "doubting Thomas" who pondered over the question later asked of her by Sir William Crookes in England, "If all the ladies should know so much about spectroscopes, who would attend to the buttons and the breakfasts?"

Her work was varied and onerous during these early years—deciding upon the instruments and putting them together when they came from Germany carefully packed in many detached pieces, lecturing before large classes, for physics was required of all candidates for a degree until 1893; demonstrating and making the experiments go off successfully without assistants until 1885.

But the very novelty of the whole undertaking was most exhilarating. Something was continually being done for the first time.

In the early eighties, Wellesley's good friend, Professor Horsford, of Harvard, offered to install incandescent electric lights in the college library. Alarm was felt among the trustees lest such lights might be

injurious to the students' eyes. Miss Whiting had already visited the Edison works in New York, and realized how different the incandescent lights were from the glaring, flickering arc lamps then in some public use, and how much better than the lights from the smoky gas manufactured by the college. She therefore obtained some Edison bulbs and offered an exhibition, for which she had to do all the work of preparation, such as setting up a battery of forty nitric cells.

An especially exciting moment came when the Boston morning papers reported the discovery of the Rontgen or X-rays in 1895 The advanced students in physics of those days will always remember the zeal with which Miss Whiting immediately set up an old Crookes' tube and the delight when she actually obtained some of the very first photographs taken in this country of coins within a purse and bones within the flesh

Her rather frequent visits to Europe always served for widening her knowledge and enlarging her acquaintance with scientific people As early as 1888, she was received at famous physical laboratories in England, including those of Sir Norman Lockyer, Thompson and Ramsay, Sir Oliver Lodge, Lord Kelvin and Lord Rayleigh. In 1896, there were more opportunities for women and she studied under Tate in Edinburgh In 1913 she attended the meeting of the International Solar Union in Bonn, Germany.

Miss Whiting's pioneer work in establishing the first experimental physical laboratory in a woman's college did not exhaust her resources, for she also became the founder of the astronomical department of Wellesley College. As early as 1879, she offered a semester of lectures in astronomy By that time Professor Pickering had become the director of the Harvard College Observatory, and he invited her there to learn of the recent development of the new astronomy along physical lines

A celestial globe and a portable four-inch Browning telescope comprised Wellesley's total astronomical equipment for twenty years. Meanwhile Miss Whiting was thinking and dreaming of a real working observatory where the telescope and the spectroscope together would tell the whole celestial story to the coming Wellesley girls At last, in 1898, her dream found a lodging in the brain of one of the trustees, Mrs John C Whitin, of Whitinsville, Massachusetts. Mrs Whitin had always been interested, as she said, in "Other Worlds than Ours," and entered into the plan with girlish enthusiasm, so that within a couple of years a beautiful observatory, of white marble with copper roof, had arisen on one of Wellesley's hills. Once more, Miss Whiting's executive ability was called into action in locating, planning and equipping the new observatory. The main telescope is a Clark 12-inch equatorial. There is also a 6-inch Clark telescope, mounted equatorially, a Bamberg broken transit, with 3-inch telescope, a Browning spectroscope, a Rowland concave grating spectroscope, and two Howard sidereal clocks, besides numerous smaller instruments and very complete apparatus for students' work

She retired from the department of physics in 1912 and devoted herself solely to astronomy, to which she also applied the laboratory method, attributing to Professor Pickering's inspiration her novel introduction of day-time observing In her little book "Day-time and Evening Exercises in Astronomy," the result of years of teaching large classes, she includes together with "Study of the Telescope" and "Use of Sidereal Clock" such exercises as classifying spectra and finding the light curves of variable stars from Harvard photographs

She trained many young women for important positions and always followed their lives with the keenest interest, desiring that their work should not only be scholarly, but that they should inspire their pupils with high ideals and prove in every way that the higher education of women was not a failure

She was a member of the American Association and the American Astronomical and Physical Societies. In 1905 the honorary degree of Sc D. was conferred on her by Tufts College in recognition of her pioneer work in physics and astronomy.

Her many years of devotion to science did not by any means deaden the social or womanly side of Miss Whiting's character. She was for years the hostess in College Hall, while many friends and alumnae will always recall with pleasure the delightful hospitality extended by Miss Whiting and her sister at the beautiful Whitin Observatory House.

She had a genius for friendship. The observatory is a memorial to her long years of friendship with its donor, Mrs. Whitin. While in London in 1896, she was a frequent visitor at Tulse Hill Observatory and formed a lasting friendship with Lady Huggins, the gifted colaborer with Sir William in laying the foundations of astrophysics. Because of this friendship Lady Huggins bequeathed to Wellesley College a rare collection of treasures including seven hundred books, fifty pictures, old jewelry and embroideries, and twelve small astronomical instruments.

Always dignified, calm and well-poised, rejoicing in the remarkable development of her chosen sciences and of her beloved college, cheered by life-long friendship with kindred spirits, sustained in every crisis by an unfailing Christian faith, Miss Whiting has left behind her the record not only of an eminently successful, but also of a singularly happy life.

Annie J. Cannon

Harvard College Observatory

SCIENTIFIC EVENTS

THE NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

The twenty-third annual excursion of the geologists of New England was held on October 14 and 15 at Worcester, Massachusetts Dean Homer P Little, of Clark University, and Professor C E Gordon, of the Massachusetts Agricultural College, acted as guides, and the veteran geologist of Worcester, Joseph H Perry, was an honored guest Other guests of note were Dr N G Horner, of the University of Upsala, and Professor L W Collet, of the University of Geneva. On Friday afternoon the Tertiary course of the "Auburn River" was studied and the Pleistocene changes of drainage were discussed The granitic intrusions at the Ballard Quarry, southeast of Worcester, offered the party an interesting study in contact metamorphism At Purgatory, in the town of Sutton, a curious valley has been explained by the late W O Crosby and his son, I J Crosby, as a graben or "keystone" fault. The evidence in favor of this theory was shown

On Saturday the party visited the Worcester "coal" or graphite mine and studied the relations of these rocks which contain Carboniferous fossils to the surrounding Oakdale quartzite. The variation of the amount of folding in the two formations led some to doubt the correlations which have been made within the Worcester basin Lunch was eaten beside glacial lake Nashua, the present Wachuset reservoir of the Metropolitan Water District

During the afternoon George Hill, in the town of Lancaster, was visited and most of the party carried away specimens of the famous Lancaster andalusites Those interested in glacial geology found the delta plains about Lancaster and Clinton excellent examples of the effects of Pleistocene glaciation. Later in the afternoon the Worcester phyllite and other of the metamorphic rocks of the Worcester basin were studied in the town of Boylston

Nineteen institutions were represented at the excursion The list includes Amherst Agricultural College (1), Brown (8), Clark (4), Colby (3), Hartford (Conn) High (2), Harvard (12), Massachusetts Institute of Technology (3), Middlebury (1), Mount Holyoke (4), Smith (4), Springfield (Mass) High (2), Union (1), University of Geneva (1), University of Upsala (1), University of Vermont (1), Wesleyan (3), Williams (1), Worcester (Mass.) High (1) and Yale (4). A number of others interested in geology were present and brought the total attendance to sixty-five or more.

W. G Foye,
Secretary

LECTURES AT THE NEW YORK ACADEMY OF MEDICINE

The following is a preliminary announcement of stated meetings of the New York Academy of Medicine for the season of 1927–1928

October 20—Carpenter Lecture—*The Present and Future Food Supply of the United States* Alonzo Taylor, director of food research, Stanford University

November 3—*Recent Knowledge of Epidemic Diseases:* Leslie T Webster, Rockefeller Institute for Medical Research, New York

November 17—Anniversary Discourse John Dewey, New York

December 1—*Malaria in Syphilis* George H Kirby, director Psychiatric Institute, New York State Hospitals; Charles W Stone, associate professor of nervous diseases, Western Reserve University, Cleveland

December 15—*Experimental Work on the Tumor Question* James B Murphy, Rockefeller Institute for Medical Research

January 5—Annual Meeting *On the Significance of Bacterial Allergy in Infectious Diseases.* Hans Zinsser, professor of bacteriology and immunology, Harvard University

January 19—*Graduate Medical Education* Louis B Wilson, director Mayo Foundation, Rochester, Minnesota.

February 2—*Alcoholism* Mattias Nicoll, Jr., commissioner of health, State of New York, Charles Norris, chief medical examiner, City of New York; Alexander O Gettler, assistant medical examiner, City of New York

February 16—*Animal Diseases in Man:* Theobald Smith, director, department of animal pathology, Rockefeller Institute, Princeton

March 1—*The Eye in Relation to Disease*. G. E. De Schweinitz, Philadelphia.

March 19—*Physical Therapy* Frank B Granger, Boston.

April 5—*Management of the Psychoneuroses* · Austin Riggs, Stockbridge, Massachusetts

April 19—*The Future of Surgery* Walton Martin, New York.

May 5—*Behaviorism and Delinquency* William Healy, director Judge Baker Foundation, Boston, John B Watson, New York.

May 17—*Recent Biological Studies and their Significance* · Edmund V Cowdry, Rockefeller Institute for Medical Research, New York.

AWARD OF JOHN FRITZ MEDAL FOR 1928

As previously recorded in Science, the John Fritz gold medal for 1928 was awarded to General John J. Carty, of New York, on October 21, for achievement in telephone engineering. This annual award was made unanimously by the board of sixteen representatives of the American societies of Civil, Mining and Metallurgical, Mechanical and Electrical Engineers, having an aggregate membership of 57,000.

This medal is awarded not oftener than once a year for notable scientific or industrial achievement, without restriction on account of nationality or sex It is a memorial to John Fritz, late of Bethlehem, Pennsylvania, long a leader in the American iron and steel industry

This is the twenty-fourth award, the first was to John Fritz in 1902 in celebration of his eightieth birthday. A few of the other medalists are Elmer Ambrose Sperry, for development of the gyroscope, Edward Dean Adams, for achievement in development of hydroelectric power at Niagara Falls, John F Stevens, for achievement in planning and organizing for the construction of the Panama Canal, building of railroads and administration of the Chinese Eastern and Siberian Railway during and immediately after the World War; Ambrose Swasey, as a designer and manufacturer of instruments and machines of precision, a builder of great telescopes and the founder of Engineering Foundation, Senator Guglielmo Marconi, for invention of wireless telephony

The members of the board which awarded the medal for 1928 were

Charles F. Loweth, chief engineer, C M & St P Railway
C. E Grunsky, consulting engineer, San Francisco
Robert Ridgway, chief engineer, Board of Transportation, New York City
Geo S Davison, president, Gulf Refining Co, Pittsburgh.
Arthur S Dwight, president, Dwight & Lloyd Companies, New York
William Kelly, mining engineer, Iron Mountain, Michigan.
J V W Reynders, consulting engineer, New York
Samuel A. Taylor, consulting engineer, Pittsburgh.
Fred R Low, editor *Power*, New York.
W. F Durand, professor of mechanical engineering, Stanford University
Dexter S Kimball, dean, College of Engineering, Cornell University
Charles M. Schwab, chairman, Bethlehem Steel Corporation
Gano Dunn, president, J G White Engineering Corporation, New York.
Farley Osgood, consulting engineer, New York.
Michael I Pupin, professor of electro mechanics, Columbia University.
C C Chesney, manager and chief engineer, General Electric Company, Pittsfield, Mass

The presentation of the medal will take place in February, 1928, in connection with the annual meetings of the American Institute of Electrical Engineers, in the Engineering Auditorium, 29 West 39th Street, New York The medal will be presented to General Carty by Robert Ridgway, chairman of the board which made the award.

FRED R. LOW, *Secretary,*
The John Fritz Medal Board of Award

THE NEW YORK HOSPITAL-CORNELL MEDICAL COLLEGE ASSOCIATION

OFFICIAL announcement is this week made to the effect that New York Hospital, at 8 West Sixteenth Street, and Cornell University Medical College, First Avenue and Twenty-eighth Street, will be united as a single medical institution It will occupy a new building, costing with the ground $15,150,000, overlooking the East River between Sixty-eighth and Seventieth Streets, Avenue A and Exterior Street, immediately north of the Rockefeller Institute for Medical Research Construction of the new building will be started in July, 1928, and it will be completed in July, 1930

The announcement says.

> The faculty and staff will be organized on a university basis, in accordance with the highest scientific standards The laboratory staff of the Cornell Medical College has long been a full-time staff In the new unified institution, the important clinical departments will be similarly manned by groups of teachers and investigators who will devote their entire time, and by other groups who give part of their time, to the work of the institution
>
> The new institution will be operated under the supervision of a joint administrative board consisting of Edward W Sheldon, president of the hospital; William Woodward and Frank L. Polk, representing the hospital, with President Livingston Farrand, of Cornell University, J. Du Pratt White, a trustee of Cornell, and Dr. Walter L. Niles, dean of the medical faculty, representing the university
>
> Dr George Canby Robinson, at present dean of the Medical School of Vanderbilt University, Nashville, Tenn., will be director of the new association, acting as executive officer of the medical faculty and coordinating the work of the medical school and the activities of the hospital
>
> The new hospital will contain about 415 public beds, seventy-five private beds and an extensive out-patient department—thus approximately doubling the present capacity of New York Hospital.
>
> Messrs. Coolidge, Shepley, Bulfinch and Abbott, of Boston, who have acted as architects for several of the more recent hospital medical college developments, including that at Vanderbilt University, are preparing plans for the new buildings.
>
> The construction of the main building, to house jointly the two institutions, will be undertaken by the hospital under the direction of Marc Eidlitz and Son, Inc., as contractors, at an estimated cost of about $11,000,000.
>
> Toward carrying out the foregoing plan, the General Education Board has authorized an appropriation of $7,500,000. This appropriation, together with the large legacies to both the hospital and the university provided for in the will of the late Payne Whitney, who died last May, has induced the two institutions to proceed immediately with the work of construction.

The combined financial position and requirements when this enterprise is completed are estimated as follows

Cost of land, new building and equipment	$15,150,000	
New York Hospital present endowment	15,000,000	
Other hospital buildings and equipment of the New York Hospital, assessed value	5,700,000	
Cornell Medical College, present and promised endowment	9,800,000	
		$45,650,000

ADDITIONAL FUNDS REQUIRED

New York Hospital, for additional endowment and other buildings	$10,000,000	
Cornell Medical College, for additional endowment	5,000,000	
		15,000,000
		$60,650,000

SCIENTIFIC NOTES AND NEWS

ACCORDING to a cable to the New York *Times*, Dr Julius Wagner-Jauregg, professor of neuropathology at the University of Vienna, has been awarded the Nobel prize in medicine for 1927, for his discovery of the malaria treatment for paresis. The Nobel prize in medicine for 1926 is said to have been awarded to Professor Johannes Fibiger, professor of pathological anatomy at Copenhagen.

THE Academy of Natural Sciences of Philadelphia presented on November 1 the John Scott medal and $1,000 to each of the following Dr. Afranio de Amaral, director of the Antivenin Institute of America, will receive the prize for the preparation of antivenins Dr. Alfred Fabian Hess, clinical professor of pediatrics at the University and Bellevue Medical School and Hospital, will be honored for his discovery of the method of producing a vitamin factor in food by the use of ultra-violet rays A prize will go to Dr Peyton Rous, of the Rockefeller Institute for Medical Research, for separating from tumor cells of fowls a substance which produces the disease. The John Scott medal was established by a bequest to the city of Philadelphia in the will of John Scott, a chemist of Edinburgh, Scotland, who died in 1816.

THE unveiling of an oil portrait of Dr Frank Billings, emeritus professor of medicine in the University of Chicago, took place in connection with the dedication of the new medical school buildings. Hanging over the fireplace in the Billings reading room of the university clinics, the portrait was unveiled at a dinner in honor of Dr. Billings.

DR. ELLIOTT C CUTLER, professor of surgery at the Western Reserve Medical School, has been elected a corresponding member of the Royal Academy of Medicine, Rome.

THE Cross of a Chevalier of the Legion of Honor of France has been awarded to Dr Chevalier Jackson, professor of bronchoscopy and esophagoscopy at the Jefferson Medical College, for his "distinguished contribution to science of medicine" The presentation was made on behalf of the French government at a private dinner by Dr J M Le Mee, laryngologist of the Paris hospitals and of the American Hospital in Paris

THE British Iron and Steel Institute recently awarded the Carnegie gold medal for the year 1925 to A. L. Curtis, Westmoor Laboratory, Chatteris, in recognition of his research work on steel moulding sand.

CHARLES A LINDBERGH will receive the Hubbard gold medal of the National Geographic Society from the hands of President Coolidge at the Washington auditorium on November 14

DR. L. O. HOWARD calls the attention of the editor of SCIENCE to the fact that, on page 391 of SCIENCE for October 28, he is made to appear as "the only American honorary member of the Academy of Agriculture of France" He states that the word "honorary" should have been omitted, since this French Academy has no honorary members He is, however, the only American member

AT the annual meeting of the American Academy of Arts and Sciences the following officers were elected: *President*, Edwin B Wilson; *vice-president for class I*, Arthur E. Kennelly, *vice-president for class II*, George H. Parker, *vice-president for class III*, George L. Kittredge, *corresponding secretary*, Robert P Bigelow, *recording secretary*, Charles B. Gulick; *treasurer*, Ingersoll Bowditch, *librarian*, Harry M. Goodwin; *editor*, William S. Franklin.

OFFICERS of Delta Omega, the national honorary public health society, were elected on October 19, 1927, as follows. *President*, Dr. C.-E A. Winslow, of the Yale School of Medicine; *vice-president*, Major Edgar E Hume, *secretary-treasurer*, Dr James A. Tobey, of New York. Chapters of the society are now established at the Johns Hopkins School of Hygiene and Public Health, the Harvard School of Public Health, the Massachusetts Institute of Technology, the Yale School of Medicine, the University of Michigan and the University of California.

DR. AUGUSTUS TROWBRIDGE, professor of physics in Princeton University, has been appointed dean of the Princeton graduate school in succession to Dean An-

drew Fleming West, who has retired For the last three years Dr Trowbridge has been on leave in order to act as adviser to the International Education Board in the appropriation of money for the development of scientific research in European laboratories

Dr. Dean Lewis, professor of surgery at the Johns Hopkins Medical School, has been appointed a member of the medical council of the U S Veterans' Bureau.

J E Morrison, secretary of the San Diego, California, Chamber of Mines, has been appointed honorary curator of minerals at the Natural History Museum, San Diego.

Dr. Floyd DeEds has resigned from the position of assistant professor of pharmacology, at Stanford University, to take the position of pharmacologist at the U S Hygienic Laboratory, Washington, D C

Dr. Guy W Clark, formerly assistant professor of pharmacology in the University of California Medical School, at Berkeley, has resigned to become director of the pharmaceutic department of the Lederle Antitoxin Laboratories

Dr. Harold E Jones, assistant professor of psychology at Columbia University, has been appointed director of research at the newly created Institute of Child Welfare, of the University of California

Dr Carl Ten Broeck, professor of bacteriology at the Peking Union Medical College, China, has been elected a member of the scientific staff of the Rockefeller Institute for Medical Research, and not to the board of scientific directors, as was incorrectly stated in an item reprinted in Science.

Professor G Ramon, of the Pasteur Institute, Paris, is at present a guest research worker in the Connaught laboratories, University of Toronto

Professor Bernard Nebel, of the University at Halle, is visiting the University of California, through an International Education Board fellowship Professor Nebel spent previously six months in Geneva, New York.

Dr Andrew M. MacMahon, recently of the University of Chicago, is abroad for 1927–28 to study the subject of electrical conduction in solids with Professors Franck, Pohl and Born at the University of Göttingen

Dr. Thomas A. Jaggar, director of the U S Geological Survey station at the Mount Kilauea Volcanic Laboratory, in Hawaii, will lead an expedition to the Pavlof Volcano group of islands off the Alaskan Peninsula next April, according to an announcement by Dr Gilbert Grosvenor, president of the National Geographic Society. The scope of the expedition next year includes the study of volcanology, physiography, wild life and botany Complete plans for the work, and for the personnel, which will include specialists in these fields to be sent by the society, are not yet finished

Colin C Sanborn, of the Captain Marshall Field Brazilian expedition, has returned from southern Brazil with further specimens of mammals, birds and reptiles for the museum

Niels Nielsen, the Danish explorer, has returned to Denmark after an expedition to unknown parts of the interior of Iceland

Dr Orland E White, formerly curator of plant breeding and economic plants at the Brooklyn Botanic Garden, has returned from Europe to assume his new work as professor of agricultural biology and director of the Blandy Experimental Farm at the University of Virginia While in Europe, Dr White read a paper on "Mutation, Adaptation, Temperature Differences and Geographical Distribution in Plants" before the Fifth International Congress of Genetics at Berlin

Dr Sven Ingvar, instructor in neurology at the University of Lund, has accepted an invitation to lecture this year at the Johns Hopkins University and has left Sweden for the United States

Dr F H Albee, professor of orthopedic surgery at the New York Post-Graduate Hospital, has been invited by the Rumanian government to give a series of lectures and demonstrations, and is now on his way to Rumania.

Dr. Rufus I. Cole, director of the Hospital for Infectious Diseases of the Rockefeller Institute, gave on October 18 the first DeLamar lecture in hygiene before the School of Hygiene and Public Health of the Johns Hopkins University on "Acute Pulmonary Infections."

Dr. John C. Merriam, president of the Carnegie Institution of Washington, will address a meeting of the American Philosophical Society, Philadelphia, November 4, on "Science and the Appreciation of Nature."

A tablet was recently installed at Williamstown, Vt., in honor of Thomas Davenport, blacksmith, pioneer inventor and builder in 1834 of an electric motor, to which a patent was granted which would cover, it is said, if still in force, every electric motor in existence

A memorial service for Louis Agassiz Fuertes, whose accidental death occurred on August 22, was held on October 30 at Cornell University, with Dr. Livingston Farrand presiding. Dr. Arthur A. Allen, professor of ornithology; Romeyn Berry, graduate man-

ager of athletics, and Dr Frank M. Chapman, curator of ornithology at the American Museum of Natural History, were the speakers

A DINNER celebrating the one hundredth anniversary of the birth of Marcelin Berthelot was held in New York on October 25, at which Dr John H Finley presided Other speakers included Ambassador Paul Claudel, of France, Dr Charles H Herty, technical adviser of the Chemical Foundation, and Dr L. H Baekeland Coincident with the dinner, a ceremony honoring Berthelot was held in the Pantheon in Paris, at which many American universities and scientific societies were represented

DR W GILMAN THOMPSON, emeritus professor of medicine at the Cornell University Medical College, died on October 27, aged seventy years

DR HOLMES C JACKSON, dean of the New York University Dental College for the last two years and previously professor of physiology in the Medical School, died on October 25 at the age of fifty-two years

DR. JULIA WARNER SNOW, associate professor of botany in Smith College and a specialist in fresh-water algae, died on October 24.

DR. BENJAMIN DAYDON JACKSON, the British botanist, curator of the Linnean Collections, died on October 12, in his eighty-second year, following an automobile accident.

THE death is announced of Dr Prenant, professor of histology in the faculty of medicine at Paris.

THE second International Conference for Plant Protection has been scheduled to meet in November, 1928, to coincide with the ninth general assembly of the International Institute of Agriculture

THE forty-fifth stated meeting of the American Ornithologists' Union will be held in Washington, D C, from November 14 to 17, by invitation from the president of the union on behalf of the United States National Museum and the Washington members The headquarters for the meeting will be at The Mayflower, where the business meetings also will be held The public sessions will be held in the U S. National Museum.

AN Organic Chemistry Symposium will be held at Columbus, Ohio, from December 29 to 31, 1927 The program will occupy the morning, afternoon and evening of each day. Only fifteen papers will be presented. Besides these there will be five colloquia on subjects of general interest to organic chemists. Those who will present papers were chosen by a general ballot of the organic division of the American Chemical Society last spring They are as follows: Roger Adams, University of Illinois; Homer Adkins, University of Wisconsin; James B Conant, Harvard University; Graham Edgar, Ethyl Gasoline Corporation; Wm L Evans, Ohio State University, E C Franklin, Stanford University; H S Fry, University of Cincinnati, Charles H Herty, The Chemical Foundation, Arthur J Hill, Yale University; C S Hudson, Bureau of Standards, Oliver Kamm, Parke, Davis & Co , E. C Kendall, The Mayo Foundation; J A Nieuwland, University of Notre Dame, James F Norris, Massachusetts Institute of Technology, R R Renshaw, New York University

THE Captain Marshall Field paleontological expeditions to Argentina and Bolivia, 1922–1927, have finished work in South America and are shortly returning to Chicago *via* the West Coast and Panama

THE hunt for a fossil deposit in the mountains of Utah, lost for fifty years, has come to an end with the receipt by the Smithsonian Institution of a collection of fossil trilobites from Mr Frank Beckwith, of Delta, Utah One of the pioneer geological surveys which opened up the West more than a half century ago discovered in the House Range of Utah a deposit of excellently preserved fossil trilobites These old collections are now in the Smithsonian Institution In later years Dr Charles D Walcott, late secretary of the institution, revisited the region a number of times and tried to find more material, but did not succeed in finding the exact spot.

THE Richard Loeb unit of the Hopkins Marine Station at Pacific Grove, for which the Rockefeller Foundation provided $100,000, has been begun. It will be a concrete structure just west of the present main building An interesting feature will be the outdoor salt-water tank, which will be built in such a way as to look like the rock on which the station stands, in order to interfere as little as possible with the appearance of the site.

THE American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, representing a membership of about 56,000 engineers, will join in giving to the University of Louvain a clock and carillon for its library tower as a memorial to American engineers who died in the World War.

A COLLECTION of four hundred and sixty-five engravings of famous old hospitals and distinguished surgeons from the seventeenth, eighteenth and nineteenth centuries has been given to the new University of Chicago Medical Schools by Charles B. Pike, of Chicago, who made a trip to Europe expressly to collect them. The university is collecting one hundred

portraits of leading contemporary physicians and surgeons to intersperse with the Charles B. Pike collection throughout the hospital. Dr. Frank Webster Jay, Evanston physician, has given the Frank Webster Jay collection of medical prints to the university for the hospital Five hundred and fifty-five portraits, prints and autographed letters of distinguished physicians and surgeons are included in the collection.

PRESIDENT HAROLD S. BOARDMAN, of the University of Maine, has announced that the income from $100,000 bequeathed to the university by the late Thomas U Coe, of Bangor, is to be used as a foundation for research, with the provision that such research work shall have some bearing on the development of the State of Maine The faculty will suggest a list of research projects The money became available to the university early this month

A $1,000,000 foundation to assure perpetual effort toward making better leather through scientific research, has been started by the Tanners' Council of America. For five years the Tanners' Council laboratory has been maintained at the University of Cincinnati and the intent of the council is to make this laboratory a permanent institution and to stimulate leather studies elsewhere

THE U. S Bureau of Standards has announced the establishment of a research associateship in its textile section by the Cotton Textile Institute The institute represents the cotton industry and the connection thus formed assures the proper functioning of the facilities of the bureau, *in so far as cotton is concerned*, along lines which will serve those most in need of authoritative data The investigations mutually agreed upon are based primarily on the needs of the consumer. A A. Mercier, who has been in charge of the experimental cotton mill at the bureau for a number of years, has been selected as a research associate for this work

THE U. S. Weather Bureau has opened a third-order station at Cape Gracias, Nicaragua, to take the place of the one formerly in operation at Swan Island, West Indies, which was closed on August 31 The Tropical Radio Telegraph Company maintains a radio station at Cape Gracias, from which meteorological observations are now radioed twice a day. This service will operate the year round.

ACCORDING to the *Experiment Station Record*, headquarters for the Ohio-Mississippi Valley Forest Experiment Station, operated by the U S. Forest Service as one of its regional stations, have been selected at Columbus, Ohio, in affiliation with the Ohio State University and the Ohio Agricultural Experiment Station The region to be covered includes Ohio, Indiana, Illinois, Iowa, Missouri, western Kentucky and Tennesse and northern Arkansas, and a series of branch stations will be established in this territory. Field work has already been begun with a study of the growth of oaks in the vicinity of Portsmouth, Ohio. The initial appropriation of $30,000 will permit of a technical staff of five men E F McCarthy, assistant director of the Appalachian Forest Station at Asheville, N C., has been appointed director

LARGER quarters at the Johns Hopkins University Medical School have been devoted to a study of causes of deafness; eventually, according to the *Journal* of the American Medical Association, it is planned to have the new enterprise reach the proportions of an independent clinic, and to extend the work to the whole field of maladies of the ear The director of this work is Dr. Samuel J Crowe, clinical professor of laryngology and otology; Dr. Stacy R Guild is in charge of the laboratory The Rockefeller General Education Board, members of the Dupont family and others have given financial aid

A STATION at which useful insect parasites are kept and bred for the benefit of agriculture has been established by the Empire Marketing Board in London. Parasites are shipped all over the empire, wherever they are needed to destroy noxious insects or plants.

ACCORDING to a statement issued by the U. S Department of Agriculture, the McKay Creek reclamation project reservoir, Umatilla County, Ore, together with small legal subdivisions of adjoining land, has been made a federal bird refuge by executive order. The refuge will be under the administration of the Biological Survey of the department. This reservoir, which is situated about six miles southwest of Pendleton, will provide a good resting place for waterfowl. Even though the refuge itself is not a specially good feeding ground, there are excellent feeding grounds in the adjacent region The lands themselves included in the refuge are under the jurisdiction of the Department of the Interior for reclamation project purposes, and the reservation of them as a bird refuge is subject to the use thereof by that department, including leasing for grazing, and to any other valid existing right.

UNIVERSITY AND EDUCATIONAL NOTES

DR. CAROLINA S. RUTH ENGELHARDT has given $5,000 to endow a lectureship at the Woman's Medical College of Pennsylvania.

A $1,000 fellowship in mathematics has recently been established at Brown University by Mr. H. D. Sharpe.

The psychological laboratory at Wesleyan University has moved into larger quarters, now occupying a floor and a half of Judd Hall. Dr Carney Landis has been made acting chairman of the department and T A. Langlie, formerly of the University of Minnesota, has been appointed instructor

A course in electrodynamics and atomic structure will be offered in the graduate school of the University of Pennsylvania this year by Dr W F G Swann, director of the Bartol Research Foundation

The North Dakota Agricultural College is organizing a new department of geology, of which Dr John E Doerr, formerly of Pennsylvania State College, has been appointed head

George C. Shaad, who came to the University of Kansas from the Massachusetts Institute of Technology in 1909 to be professor of electrical engineering, has been appointed acting dean of the school of engineering and architecture, to succeed the late Perley F Walker

Dr Moses Gomberg, professor of organic chemistry at the University of Michigan, has been appointed chairman of the department of chemistry of the university

Professor W C Rufus has returned from a year with the World Educational cruise to resume his regular work in the department of astronomy of the University of Michigan Dr Dean B McLaughlin, of Swarthmore College, has been made assistant professor in astronomy Dr Allan D Maxwell comes to the university from Lick Observatory and Dr Hazel M Losh from Mt Wilson

Paul L. Hoover, research fellow in electrical engineering at Harvard University, has been appointed assistant professor of electrical engineering at the Case School of Applied Science.

Dr. Charles C Mook, of the American Museum of Natural History, has been appointed assistant professor of geology in the Washington Square College of New York University

Dr. H. M. Harshaw, of the University of Missouri, and Dr. H. A. Pagel, of the University of Minnesota, have been appointed to instructorships in the department of chemistry of the University of Nebraska

R. W. Thatcher, of Washington University, has been appointed instructor in geology at Oberlin College. Mr. T. J. Pettijohn, who has been instructor in geology at Oberlin for two years, is now holding a fellowship at the University of California.

T. G. B. Osborn, professor of botany at Adelaide University and consulting botanist to the South Australian government since 1912, has been appointed to the chair of botany at the University of Sydney.

Dr Tom Hare, of the Lister Institute of Preventive Medicine, London, has been appointed to the chair of pathology at the Royal Veterinary College

DISCUSSION AND CORRESPONDENCE

OLD PROBLEMS WITH NEW ILLUSTRATIONS

It is a truism that the scientific investigator must find his reward largely in the joy of the work itself. Material compensation is not looked for, and even recognition is a secondary matter. It would seem, however, that this very fact makes it more imperative that any one writing a general article or a text-book covering a particular field of investigation be scrupulously careful to give full credit at least to the more prominent workers in this field

Again, we all suffer from the effects of "newspaper science", sensational articles written by irresponsible reporters *Science Service* was organized to combat this evil Does not this impose upon those engaged in scientific work the moral obligation to avoid sensationalism, exaggeration and loose statements in popular articles which they write?

These are not new questions, responsibility of writers to their colleagues, to the students who use their text-books, and to the general public is a matter that has been the subject of thought and discussion for many years. My recent reading, however, has led me to consider it anew

The astronomer is aware that the late Professor James E. Keeler, by his brilliant work with the Crossley reflector, focussed attention sharply upon the advantages of this type of telescope for certain classes of photographic observations, and that in the course of his work he directed attention to the great number of the spiral nebulae (previously regarded as rather unusual objects) and to their significance in theories of cosmogony. The astronomer knows, too, that to Professor H H. Turner, "more than to any other man, is owing the development by which photographic methods have become the most accurate and rapid of all ways of determining differential star positions." Again, he knows that Professor A. O Leuschner has done quite as much as any man (in America at least) to develop modern methods of computing orbits of comets and minor planets, and to increase our knowledge of the motions of these bodies.

The astronomer, I say, knows these facts, but how is the student who uses a recently issued text-book in astronomy to find them out when Keeler is mentioned only in relation to the revolution of the Rings of Saturn and Turner and Leuschner are not named at all? These are but three of the more striking omis-

sions in this particular book Some recent books on astrophysics are quite as badly at fault in this matter One, for example, makes no mention of Huggins, Keeler, Langley or Vogel!

Again, every astronomer is aware that the total number of stars in our stellar system is an unknown quantity, though we arrive at *estimates* of this number by extrapolation Thus,[1] in what is probably the most careful and reliable investigation of the number of the stars that has so far been made, it is said, "the *assumption* that these formulae [i e, the formulae which represent the number to the 21st photographic magnitude] also apply to the luminous stars *beyond observational reach* leads to 3×10^{10} [30 billion] as the total number of stars in the galactic system" (italics mine) He knows that *measures* of stellar diameter are possible at present only by means of the interferometer and that these diameters when given in linear units (miles or kilometers) depend in part upon the adopted distance (parallax), which may be uncertain by 25 per cent or more of its total value. *Antares*, for example (which is the largest star of measured diameter, unless, perhaps, *Mira Ceti* slightly exceeds it), has a diameter of 280,000,000 miles on the basis of one assumed parallax, and of 430,000,000 on the basis of another, the former being probably (but *not* certainly) the more reliable

But in a recent popular article, printed in a journal of high standing and later reissued as a reprint by the observatory with which its author is connected, we find the categorical statements: "Our Milky Way system contains about fifty billion stars," and, a star is "a sphere of glowing gas varying in size from a globe not much larger than the earth to one *a thousand times larger* (italics mine) than the sun in diameter," *i e*, more than 860 million miles, or double, possibly treble, the value of the star of largest measured diameter.

The author also remarks blithely that "fifty billion years is but a short interval in the life of the average star," which may (or may not) be true, but is certainly not a demonstrated fact Furthermore, he lets the reader infer, as a friend pointed out to me, that the Magellanic Clouds have recently moved so far north that their radial velocities can be and have been measured from Mount Wilson or Flagstaff!

The question is this Is it quite fair to the intelligent public to give the impression, which the average reader will certainly gain from this article, that these figures and dimensions are matters of knowledge and on the same footing as our knowledge of the distance to the sun or of its diameter? Does not the writer of such an article owe it to his reader to make it clear that some of his results rest upon theories, assumptions and extrapolations, all of which, though they may now seem to us to be well-founded, may be subject to revision—possibly even to rejection—in the light of further investigation?

Finally, to revert to my opening paragraph: while every scientific investigator is concerned primarily with the advancement of knowledge, and not with his own fame, is it not his due to be given recognition for his work in books that record for the student the chief steps in the development of his science?

R. G. AITKEN

[1] "Mean Distribution of Stars according to Apparent Magnitude and Galactic Latitude," by F H Seares, P J van Rhijn, Mary C Joyner and Myrtle L. Richmond *Contrib Mt. Wilson Obs.*, No. 301, 1925.

ON MANSON'S EYE WORM IN POULTRY

IN certain sections of Florida, especially the seacoast areas, quite severe outbreaks of Manson's eye worm (*Oxyspirura mansoni*) in poultry occur each year, occurring most frequently during the rainy season of the summer months. Due to its economic importance, and also since its life history was unknown, a detail study of the parasite was begun in November, 1925, by Dr. D. A. Sanders, of the veterinary department, Florida Agricultural Experiment Station

The first experiments conducted were simply exposure tests to determine if the parasite would pass from infected to non-infected birds kept under continuous exposure It was impossible to transmit the parasite by simple exposure of non-infected to infected birds

Experiments were conducted in an effort to produce infection by placing eggs containing embryos of the parasite into the eyes of non-infected birds. It was impossible to produce infection in this manner.

It was also found impossible to produce infection by placing newly-hatched larvae into the eye of non-infected birds.

From the above-mentioned experiments, it was quite apparent that an intermediate host was necessary in the development of the life cycle of Manson's eye worm. Search for the intermediate host was begun, and this search included examinations of many of the insects most commonly found around the premises of the poultry flock. After examining many insects, finally specimens of *Pycnoscelus* (*Leucophaea*) *surinamensis* Linn., a species of cockroach, were examined and encysted larvae of the eye worm were found in the body cavities of some of these roaches. Larvae were taken from the infected roach, and when placed into the eyes of birds, these larvae remained therein and produced infection. Larvae were taken from the body of a roach and placed into the mouth cavity of non-infected birds with the result that

shortly afterwards, the birds showed infection of Manson's eye worms. Whole roaches were fed to non-infected birds with the results that within twenty to thirty minutes after the birds had eaten the roaches containing larvae, the parasites had reached the eyes of these birds

The results obtained by Sanders in Florida confirm the work of J. W Fielding as reported in *The Australian Journal of Experimental Biology and Medical Science* Vol III (1926) that *Pycnoscelus* (*Leucophaea*) *surinamensis* is the intermediate host for Manson's eye worm of poultry However, the work of Sanders in finding this intermediate host was done independent of Fielding's work

The mature parasites are located in the tear sinus just beneath the third eyelid or nictitating membrane In some cases, birds harbor only one or two parasites, while in a severe infection as many as fifty or more parasites may be present in the eyes The mature parasite is 14–18 mm in length and thread-like in diameter.

It is possible to infect many different kinds of wild birds by feeding them infected roaches

A. L SHEALY

AGRICULTURAL EXPERIMENT STATION,
UNIVERSITY OF FLORIDA

RE NOMINA CONSERVANDA

EVEN after being so professorially lectured in SCIENCE[1] in an article which could more appropriately have appeared in the same medium as did the paper it attacks, the writer wishes to reply only to the extent of clearing up possible misapprehensions in the minds of readers.

By implication the writer is classed with those having the "mihi itch" in an objectionable form He would state therefore that his object from his very first paper on entomological taxonomy has been to do essentially revisional work that would have a maximum of teaching value to younger entomologists and be a real aid to identification of species in the hands of more advanced students. To date he has been sole or joint author of fifty-two articles dealing with the classification of insects and thirty-nine of these are revisional in scope or at least include keys. The piling up of mere descriptions of new species has never been his object; but on the contrary is an activity he heartily condemns At the same time he believes that personal interest in achievement is no more lacking in taxonomic work than in other fields of human endeavor, and that this is only as it should be, altruistic platitudes to the contrary notwithstanding.

[1] Bradley, J. Chester, 66, 100–103, July 29, 1927.

Professor Bradley insists on the separability of taxonomy and nomenclature, but passes over the writer's suggestion that a code of vernacular or other names could be used by general biologists that would have no necessary connection with technical taxonomy

Bradley's reference to general zoologists, morphologists, etc, riding rough shod over taxonomists is certainly well put, for just that is what has been attempted in the making of nomina conservanda. Taxonomists deal constantly with morphology and use morphological terms almost as much as the morphologists themselves, yet they have not attempted to dictate standardization of anatomical terms, new ones of which are constantly being introduced Taxonomic nomenclature is no more the language of science than is anatomic nomenclature and is no more subject to dictatorial rule

Bradley ends on a note of not becoming a slave to rules, which he may be sure finds an echo in the breasts of men so individual and independent as taxonomists usually are They desire to be the slaves neither of rules nor of rulers (*i.e*, of Committees and Congresses)

W L MCATEE

EARTHWORMS AND SPECTRAL COLORS

THE article by W R Walton on "Earthworms and Light" in SCIENCE for August 5, 1927, recalled to me some research I did in this line some years ago but did not publish

For the experiment I used a box about two and a half feet long, two feet wide and eighteen inches high. This I thoroughly blackened inside For light I used gas with a mantel and a reflector The light was passed through a carbon-di-sulphide prism The light fell on a white paper in the bottom of the box Into this array of spectral colors I dropped angleworms. As they moved to get away from the light they always went out the red end They would pull back from the blue as if it hurt them and turn toward the red. This reaction occurred with every worm except one. This worm lay full length in the green and stayed there. I was not able to repeat this last reaction.

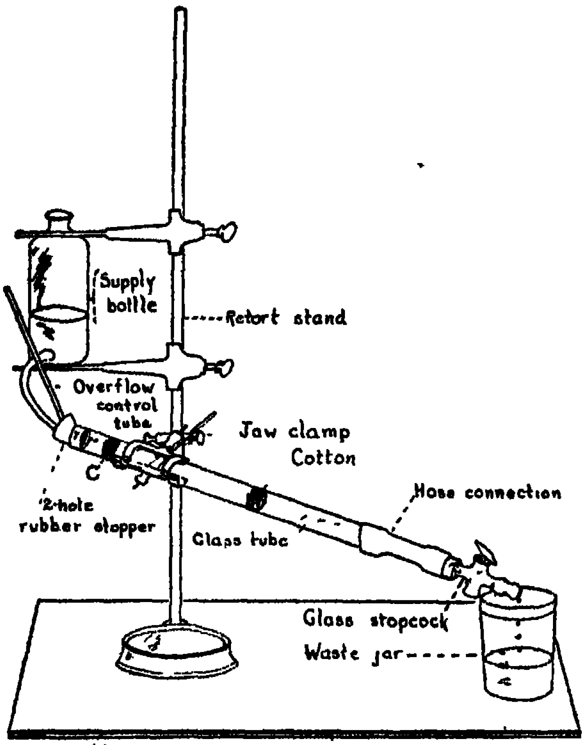
G. H BRETNALL

BAKER UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE AUTOMATIC DEHYDRATING APPARATUS FOR MANY SMALL OBJECTS

THE accompanying figure represents a very satisfactory apparatus for changing fluids on many small objects. It grew out of the need for saving time in handling ovaries of mice. It is essentially a glass



Automatic device for changing fluids on many small objects

FIG 1

tube about 300 millimeters long by 16 millimeters inside diameter supported at an angle of about 30 degrees, fitted with a glass stopcock at the lower end and with a 2-hole rubber stopper at the upper, through which fluids are conducted from the supply bottle. The overflow tube fitted into the rubber stopper serves two purposes When the large glass tube is being filled from the supply bottle, it allows air to escape, and also prevents overflow when the tube is full and the stopcock closed. A retort stand fills all the needs of a support, if fitted with rings and clamps as shown in the figure. Other means of support are readily devised. The supply bottle is of the aspirator type.

As used by the author, each ovary is put into a short piece of small glass tubing, the ends of which have been smoothed on a small emery wheel. The corresponding number is written in pencil on a small strip of paper and placed with the ovary in the tube, which is then wrapped in a piece of loosely woven cotton cloth, fastened at the side by either thread or fine copper wire, leaving only one layer of cloth over each end of the tube Many of these small tubes, each with its numbered ovary, are placed in the large glass tube which is filled with the appropriate fluid, clamped in place, connected to the supply bottle as shown, and the desired fluid allowed to flow in. For example, if the next step is to pass from 80 per cent. to 95 per cent. alcohol, this latter fluid is placed in the supply bottle, and the glass stopcock adjusted to a very slow rate of dropping, perhaps one drop per second. The 95 per cent alcohol passes very slowly into the tube at the upper end, is diluted and the mixture gradually works its way downward Ultimately the tissues are in 95 per cent. alcohol. By placing a small loose wad of absorbent cotton at the two places indicated in the figure (C and cotton), it was seen by admitting colored alcohol from the supply bottle into water or a low grade of alcohol in the glass tube, that the front of the new mixture moved evenly, thus proving that all the objects in the glass tube would be affected serially from top downward.

It is wise not to put tissues between the upper wad of cotton (C) and the 2-hole rubber stopper, as the amount of fluid contained in this space allows mixing of the two fluids, which prevents too sudden a change on the upper pieces of tissues. The large glass tube holds about fifty of our small glass containers, which measure about 15 *mm* long by 5 *mm* inside diameter These are easily cut in the laboratory. The large glass tube and the small containers may be varied in size according to the needs of the user, but it is likely that if the large tube is much greater in diameter the flow of the fluid might be difficult to control evenly Several tubes may be filled and joined end to end for simultaneous treatment.

The inflow may be checked at any time by closing the glass stopcock. Tissues may remain immersed any length of time in a particular fluid without loss of fluid by evaporation. They may be fixed, washed, stained, dehydrated and cleared without further handling. So far as the author can see, this device is as reliable as an air current or a mechanical agitator The user will realize the necessity of a very slow movement of fluids. The dropping may be regulated to any rate desired, from less than a drop per second to as many as may seem best. The clearing fluid should probably be added more slowly than the alcohols, and be started in a mixture with 95 per cent. or 100 per cent. alcohol. In placing the small containers in the large glass tube, one should avoid closing either end by contact with another surface. Small animals and some hard tissues may be kept separate by mosquito netting or cloth sacks only.

If the apparatus is used for staining it is well to make new paper labels before infiltrating the tissues with paraffin, as pencil marks are likely to be dimmed if the stain remains in the paper, and consequently difficult to read when covered with paraffin. Paper labels may be avoided by numbering the small glass tubes and keeping complete corresponding records.

Used fluids may be preserved, account being kept on the labels of the number of times used.

EZRA ALLEN

CARNEGIE INSTITUTION FOR
EXPERIMENTAL EVOLUTION

SPECIAL ARTICLES

SURVIVAL OF ABILITY

HAVING found from two different sources unmistakable confirmation of an earlier research of mine showing that mental evolution is going on to-day through a process of natural selection, I would like to present briefly the results, as the full publication may be for some time delayed

It is often stated that there are now no forces at work to lead towards increase of brain power, because the primitive struggle for existence has ceased to be operative under present conditions of civilization, in which the weak and incompetent are bolstered up and the poor and shiftless are allowed to have many offspring

It appears, however, that society is being divided into two classes, a small percentage of "aristocrats" and a large percentage of proletariat.[1] Within the so-called aristocracy there is taking place a genuine process of survival of the fittest in which the more ambitious, successful and intellectually eminent are having a larger number of children than their friends and relatives who are less well endowed

In studying the royal families of Europe I found this to be the case (see "Heredity in Royalty," 1906) Now I have found it to be the same among Harvard graduates and also in the British peerage.

Mr A. E. Wiggam, writing in the *World's Work* for November, 1926, page 32, makes comment upon the figures for Harvard graduates, which I sent him as confirmation of a belief I have held for twenty years that by-and-large all good human qualities are correlated and therefore mental evolution must continue Also such facts give an added justification for eugenics and a brighter outlook for the future of mankind. This point of view is contrary to the attitude of Conklin, Pearl and Castle if I interpret their writings correctly, but is accepted by Thorndike; and I think by Terman judging from this same article by Wiggam.

This announcement of mine regarding Harvard graduates has apparently stimulated a number of people to look up the records and see if it be true This I gather through correspondence. John C Phillips writes me that he is finding confirmation. No figures have as yet been published. Those which I possess are for only four graduated classes, '90, '92, '94 and '98 I had hoped to include '96 for the sake of symmetry but the figures as they stand are sufficient to make the conclusion almost certain that judged by the oft-used standard of success, "Who's Who in America," the graduates who are parents of three or more children are a little more likely to be in "Who's Who" than those with less and much more likely than the bachelors. All figures are taken from the class books made up on the twenty-fifth anniversary after graduation, which books have at least the appearance of approximately sufficient care, accuracy and completeness.

PERCENTAGES OF HARVARD GRADUATES IN "WHO'S WHO IN AMERICA," 1924–25

Number of Living Children

	Unmarried	0	1	2	3	4 or more
Class of '90	15 2	19 40	22 92	18 27	24 45	14 26
" " '92	14 75	14 10	18 75	22 81	20 76	18.92
" " '94	6 25	20 0	13 33	18 07	22 45	25.45
" " '98	2 63	12 26	12 64	8 0	8 0	13.73
Averages	9 71	16 44	16 91	16 79	18 92	18.09

It can be seen from the figures that no one would suspect from the data regarding any single class, that any such truth lay buried Take the Class of '90, for instance, which was the first investigated Here the unmarried have actually a higher percentage of inclusion in "Who's Who in America" than those with four or more children The grand average, however, smooths the curve out, giving the two highest percentages at the right, 18.92 and 18.09, with the lowest at the left, 9 71, for the bachelors The remaining figures are satisfactory though the rise is not perfectly uniform If we add the percentage of the bachelors to the married without children, and divide by two we get 13.08 for the childless compared with 16.+, 16+, 18+, 18+ for the other four groups. The total number of individual cases studied is well over 1,000, which is the number usually necessary in correlation investigations.

This confirmation of the results from the royal families led me to believe that the same truth would undoubtedly be found in the records of the British peerage, namely, that the more notable or able, are (within any one homogeneous social class), the ones who have the largest number of living children. The well-known "Burke's Peerage" is an exceedingly complete and accurate book. I have divided all the peers (Edition of 1921) into two groups: first those whose male lines are traceable as early as 1450, and second,

[1] See F. A. Woods, "Social Conification," in Proceedings of Second Eugenics Congress, 1921. Published in "Eugenics, Genetics and the Family," 2 vols., Baltimore, Md.

those whose male lines are not traceable to such an early date This bears on the average some relationship to the date of elevation to the peerage, but that is another matter

These in the first group are the peers who belong to the very old families, so-called They constitute about half of all the peers Their family names are well known to everyone conversant with English history

As regards their achievements, which must be in a considerable degree due to a mixture of ability, vitality and ambition, they have all been placed in two groups. First, a comparatively small group who have done nothing or next to nothing in the way of rendering public service and, second, a majority group whose public services appear to have been both genuine and continuous Naturally there are border-line cases difficult to place, but these are not very numerous and I have been careful to place the doubtful cases in such a way that they would count against rather than in favor of my theory Only those over 34 years of age have been included

All who have been elected members of parliament or risen in the navy to the rank of commander or colonel in the army (not honorary colonel), also those who served in the great war, have been included in the "service" group as well as the few business and professional men Both "Burke" and "Who's Who" have been consulted for each case Generally speaking if there is anything in their biographies that can be called "service" they have been included in this group

In spite of this liberality of inclusion in the "service" group there are about 68 among the peers of the newer families whose achievements appear to be either nothing at all, or very inconsiderable. These have 138 living children, which gives an average of 2 03

There are about 274 peers of the newer families who come within the "service" group. These have 640 living children or an average of 2.33. An even greater rise is to be found in favor of the greater fecundity of the peers who have rendered "service" when we summarize the facts concerning the older families Here about 70 peers with little or no public service to their credit have 131 living offspring or an average of 1 87, while 210 "service" peers have 610 living children. The average for living children here rises to the surprising height of 2 90

The English peers evidently want children and they have them. The best among them apparently want them the most, so that in spite of the large number of sons killed in the war, this special caste of humanity is more than holding its own

Dr J McKeen Cattell and others have shown that parenthood to-day is largely a voluntary matter, at least among the more intelligent classes. The desire for children is doubtless in part an instinct and as far as it is an instinct should be subject to hereditary transmission It is in all likelihood correlated with such virtues as domesticity and stability. It appears from these figures to be also correlated directly with intelligence and ambition. When we reach the type of ability generally called genius there is again a falling off in the number of offspring, but it is a matter of satisfaction to know that within the different groups of humanity there is by-and-large a survival of ability

The average for total offspring for all college graduates is lower than it ought to be to keep up the type For all Harvard graduates it averages below two Some may say, "What is the use of survival of ability when if this goes on long enough there will not be any ability left to survive" The answer to this is a long one and can only be indicated here Voluntary parenthood is a recent phenomenon. The average for all graduates, *circa* 1 5, rises for the more successful to *circa* 1 6 As nowadays only those who want children have them, the children should themselves inherit this temperament. This is a new condition which did not exist until recently. From now on this inheritance of the parental instinct should in a few generations restore the number to a little over two, which is necessary for a continuance of the breed

It is true that the people of the slums are having undesirably large families, but this class is now almost entirely separated as far as intermarriage is concerned from the upper classes—more so in England than in the United States, but increasingly so on both sides of the Atlantic. It is probable that an intensive study of families within the slums where brother could be compared with brother and sister with sister would show the same result, namely, the better members of the family having the largest number of surviving offspring.

FREDERICK ADAMS WOODS

QUANTITATIVE HYDROLYSIS OF STARCH BY BUFFERED TAKA-DIASTASE

THIS work represents an attempt to eliminate the use of acid hydrolysis in determining the starch content of plant material.

The standard method is the "maltose hydrolysis." This consists in treating the alcohol extracted materials with taka-diastase in water solution, filtering off the insoluble residue, and heating the filtrate with dilute acid to hydrolyze the dextrin and maltose to

glucose. The glucose content of the solution may then be determined by any standard method

This procedure is open to criticism in that the water extract will contain any water soluble substance originally present in the material unless it was dissolved out by the alcohol. Since pentosans are insoluble in alcohol and soluble in water they may be present in the water extract These, if present, would be hydrolyzed to reducing sugars by acid, and recorded as starch

It is, therefore, desirable to use, if possible, a hydrolyzing agent more specific than acid Enzymes in general are specific in their actions, and taka-diastase is the most efficient of the enzyme mixtures which attack starch Much work has been done upon the optimum conditions for enzyme activity The optimum temperature range for taka-diastase is 30°–40° C[1] The optimum pH is 4 5–5 0[2] The hydrolysis curve begins to flatten at 50 hours[3] and 2 gm of enzyme is sufficient to dissolve 5 gm starch[4] Most of this information is in Waksman and Davison, "Enzymes," but curiously, data could not be found indicating that any one had put it all together Kuhn[5] reports a curve for the hydrolysis of starch by taka-diastase at pH 4 5 for 50 hours at 36° C in which he obtains 71 4 per cent hydrolysis He used 2 cc of .5 per cent enzyme solution for 603 gm starch, so that it is probable that the quantity of enzyme was the limiting factor in that experiment Horton[6] working with unbuffered solutions reports that it is impossible to obtain consistent results with taka-diastase. In this laboratory, when 50 cc of 3 per cent. starch solution was held at 40° C for 36 hours with 1 cc 10 per cent taka-diastase and 5 cc acetate buffer (pH 5 0), glucose values representing 98.5–101 1 per cent. hydrolysis were obtained consistently.

The substrate was potato starch which had been purified by repeated washings with distilled water and dried in a vacuum oven at 120° C over phosphorus pentoxide to constant weight[7] The starch was not caramelized by this treatment Furthermore, the analysis of undried starch of known moisture content gave concordant results The reducing sugar was determined by the Schaffer-Hartmann[8] modification of the Munson-Walker method. The amount of reducing sugar produced by a maltose hydrolysis on another aliquot of the same solution was taken as the standard of complete hydrolysis

Reducing the concentration of taka-diastase to ¾ did not decrease the amount of glucose formed, and ½ the amount of enzyme gave 95.6–99 0 per cent. glucose It was impossible to obtain consistent results at pH other than 4.5–5 0 with acetate buffers. A phosphate buffer at 4 5 gave 100 1 per cent glucose.

In view of the present interest in the structure of starch it is interesting to note that both acid and enzyme hydrolysis consistently gave results equal to 93 per cent, the dry weight of the sample It is possible that the starch was impure and contained only 93 per cent hydrolyzable material Davis and Daish[9] working in England, report that acid hydrolysis of potato starch gives 93 8–94.5 per cent, the theoretical amount of glucose They attribute the low results to destruction of glucose by the prolonged treatment with acid If the enzyme hydrolysis be inaccurate, the fault probably lies in incomplete hydrolysis and the establishment of an equilibrium between dextrin, maltose and glucose It seems improbable that this equilibrium point should coincide with the point reached by the destruction of glucose by acid hydrolysis Noyes[10] says that the analytical ratio between starch and glucose is 93 The agreement between these three figures may be coincidental, but the point should be further investigated

The method seems to give concordant results with pure starch, and one series of determinations on grape wood gave values identical with those obtained by the maltose hydrolysis, but the method needs more work before it can be considered reliable The specificity of taka-diastase for hexonsans should be more carefully investigated It is also possible that the time required for a determination may be shortened by the use of more concentrated enzyme solutions, or a different temperature

I D Collins

Viticulture Laboratory,
University of California

1 Euler, Chemie de Enzyme (Waksman), Kuhn, R, Berichte der Chem. Gesell 1924, 57 · 2, 1965.

2 Ibid.

3 Ibid.

4 This laboratory.

5 Kuhn, R.; Berichte der Chem. Gesell 1924, 57: 2, 1965.

6 Horton: J. Agr. Sci., 1921, 11. 240.

7 Walker: J. A. C. S, 1907, 29: 54.

8 Schaffer and Hartmann: J. B C., 1920–21, 48: 371.

9 Davis and Daish: J. Agr Sci., 1914, 6: 152.

10 Noyes: J A C. S., 1904, 26: 266.

THE NATIONAL ACADEMY OF SCIENCES

(Continued from page 406)

Studies in animal aggregations, protection of the individual by the mass W. C Allee (introduced by Frank R. Lillie). The injurious effects of crowding are easily demonstrated and have received due attention Beneficial results from aggregations of animals without apparent social organization have escaped notice until recently,

when group survival value has been demonstrated for various land isopods and for the brittle starfish, Ophioderma, under starvation (Allee), for many animals when exposed to toxic reagents such as colloidal silver (Drzewina and Bohn, Bresslau, Allee and Schuett), and for certain marine turbellarians when exposed to hypotonic sea water (Drzewina and Bohn) Groups of starving individuals show a modified rate of oxygen consumption as compared with wholly similar isolated animals This appears to be correlated with changes in muscular tonus. Two explanations have been advanced for the protection furnished by numbers in toxic solutions Drzewina and Bohn postulate an autoprotective secretion which enables the animals comprising the group to withstand the toxic action better than isolated individuals The other workers find that with many reagents a large part of the protection is due to the greater fixation, by absorption or otherwise, of toxic material by the group. This leaves open the question of the production of a protective substance Recent critical experiments demonstrate that the marine turbellarian, Procerodes, lives longer when a number are transferred to tap-water than do similar but isolated individuals in the same amount of tap-water. The greater survival value of the group is not wholly due to greater salt transfer, for greater protection is furnished by the filtrate from groups than by tap-water containing a larger amount of sea-salt. The protective material is given off both by living and by dead animals and once in solution will pass through ordinary filter-paper and will persist after the filtrate is brought to a boil. The results confirm the author's earlier suggestion of the existence of methods of integration in ecological animal communities more subtle than the food and space relations usually considered, and demonstrate a mechanism of cooperation among individuals comprising even loosely integrated animal aggregations.

The influence of a changed environment in the formation of new species and varieties FRANK COLLINS BAKER (introduced by S. A Forbes) In Barron County, Wisconsin, near Chetek, a series of small creeks and rivers were transformed into a number of large, shallow lakes by building a dam which ponded the waters for a distance of some eleven miles The lakes were completed some sixty years ago for lumbering operations. The original molluscan inhabitants of this region were creek and small river species Those mollusks that remained above the dam were quickly transferred from a creek habitat to a lake habitat. Many of these, such as the naiads, *Fusconaia, Elliptio Lasmigona* and *Strophitus*, as well as the gastropod, *Campelona*, either migrated upward to the remaining part of the creeks, Moose Ear and Pokegoma, where the fauna was unchanged, or became exterminated Certain other species of both naiades and gastropoda, *Anodonta grandis plana, Lampsilis siliquoidea, Amnicola limosa, Stagnicola catascopium, Helisoma antrosa* and *Helisoma trivolvis*, remained in the newly ponded waters and in the course of sixty years have become modified into recognizable varieties, several of which occur widely distributed in the lakes formed after the retreat of the ice following the Wisconsin stage of glaciation. The changes in the form of the shell resulting from the change in environment have been, in the naiades, a shortening of the shell and an increase in obesity, and in one case, *Lampsilis*, of a greatly increased height In the gastropods, *Amnicola, Helisoma, Stagnicola*, the result has been an inceased globoseness and a widening of the umbilical region, in short, a loosening of the coiling of the whorls, whereas in the creek forms the whorls are coiled more tightly, leaving a smaller umbilical perforation The result of this unintentional experiment, conducted on so large a scale and during such a long period of time, is conclusive proof, it would seem, that the environment does have a modifying effect on such plastic animal life, the degee of differentiation varying with the inherent variability of the organism. What has taken place in the Chetek Lake region is without doubt similar to the changes that occurred in the animal life of the waters following the different glacial invasions of the Ice Age, when the life, which has been driven southward by the ice, returned after its recession to find, instead of river systems, like that now existing in the Driftless Area of Wisconsin and Illinois, a vast system of lakes, which it invaded and in which it changed from one species or variety to another by the process of small variations like those shown to have taken place in the Lake Chetek region during a period of less than a century.

Energy metabolism as related to the plane of nutrition of cattle: E B FORBES A study of the economy of utilization of the energy of feed by cattle was made at the Pennsylvania Institute of Animal Nutrition by means of a respiration calorimeter. This calorimeter, which is the only such apparatus in the world of the size necessary for large farm animals, permits of the direct measurement of the heat given off by the animal, as well as the determination of all factors of material outgo. In a duplicate series of energy balance studies with two steers, at five planes of nutrition, from fast to full feed, it was shown that the loss in heat per unit of weight of feed (the heat increment), increases with each increase of feed, but the rate of increase in heat increment is such as to be expressed not by a straight ascending line but by a curve falling from such a line. By the subtraction from the gross energy of the feed of all losses and expenses of utilization—namely, the potential energy of the visible excreta and of the methane produced by fermentation in the paunch, and the increased heat loss due to the consumption of the feed, the net energy available to the animal for maintenance and body increase was derived. The total net energy per unit of feed was found to decrease in a simple proportional manner with increase in feed; but in order to be able to compute separately the feed requirements for maintenance and production, for guidance in feeding practice, it is necessary to determine separate net-energy values of feeds for these purposes. Using the heat production of the fasting animal as the measure of the maintenance requirement of net energy at all planes of nutrition, it is proposed that one net-

energy value be used as the basis for computing the entire maintenance requirement of feed. Then a second lower net-energy value would represent all feed used for body increase. Net-energy values of alfalfa hay and corn meal, for maintenance and for body increase, computed by a new procedure, are presented

The origin and destiny of prairies HENRY C. COWLES (introduced by John M Coulter) Many theories have been advanced to explain the treelessness of prairies None of these has been generally accepted as adequate, and yet it is likely that most of them have some degree of validity One of the major difficulties has arisen from lumping together prairies of many sorts and seeking a common explanation for them all. In this paper the attempt is made to sort out the major prairie types into three groups, which may be called climatic types, edaphic types and tension line types The edaphic and tension line prairies are regarded as having a forest density, but the climatic prairies are believed to be more permanent. Recent soil studies show interesting interchanges between prairies and forests, and shed much light on various aspects of the prairie problem.

Reflection of light from the surface of leaves CHARLES A SHULL.

The isolation of a crystalline protein with tuberculin activity FLORENCE B SEIBERT In the case of tuberculin, as with other biologically active principles, toxins, etc, there has always been the question as to whether the specifically potent factor is a protein or merely an infinitesimal amount of some very highly active substance attached to the protein The difficulty in solving these problems has been due to the fact that the purification of proteins is one of the most difficult chemical tasks there is. Many previous investigators, beginning with Koch himself, have thought the active principle of tuberculin, which is responsible for the skin reaction in tuberculous subjects, was protein and all of the evidence from our laboratory during the last three years, i.e, experiments based upon chemical analyses, dialysis, precipitation and hydrolysis, have consistently confirmed this view. Chief among the evidences is the fact that when the water-soluble protein obtained from tuberculin, that had been made in a non protein medium, is treated with the proteolytic enzymes, pepsin and trypsin at the proper reaction, there is a loss in biological activity, paralleling a chemical break-down in the whole protein molecule to proteoses, peptones and amino acids. This evidence, together with the fact that the water-soluble protein, when not denatured, will crystallize into needles or burrs which after five or ten recrystallizations are still potent biologically, would seem to leave very little further doubt as to the protein nature of the active principle The protein is crystallized by Hopkins' method for crystallizing ovalbumin at an optimum hydrogen-ion concentration point of pH 4.9. One lot of crystals, after fourteen crystallizations with solution in distilled water and filtration through hardened filter-paper between each crystallization, gave the following protein tests. They were heat coagulable, gave positive biuret, Millon's, vanillin, ninhydrin and glyoxylic tests, a negative Molisch test and stained blue with methylene blue. The crystalline protein is purer and therefore more potent than the original water-soluble fraction of tuberculin from which it is made, as indicated by the following test. One tenth of a milligram of the original fraction is required to produce a maximum skin reaction in tuberculous guinea pigs, whereas, of the protein obtained from it and recrystallized ten times, as little as 0 04 mgm., measured as coagulable protein, sufficed to give an equally strong reaction. Throughout the experimentation evidence has accumulated for the following interpretations The protein in tuberculin in its most natural and unchanged form, is crystallizable into needles and burrs, but it is an extremely labile protein very readily becoming less soluble in distilled water and then not crystallizable. This less soluble protein is still biologically active, but loses all or most of its activity with a further change to complete insolubility in distilled water This denaturization and instability of the protein in water explain the small yield of crystals obtained and the great losses in activity during isolation of the protein and emphasize the importance of using the quickest and least drastic methods possible when the highest yields of most potent material are desired. In the case of tuberculin, therefore, there seems to be sufficient evidence to warrant the conclusion that the active principle is protein It is a specifically toxic bacillary product and a protein obtainable in crystalline form, thus passing the first criterion of purity from a chemical standpoint This work has been aided by a grant given to Dr E R Long by the National Tuberculosis Association, for whom the H K. Mulford and the Parke, Davis Co. have supplied the tuberculin in large quantities.

Are arginine, glutamic acid and aspartic acid necessary components of the diet during growth? W. E. BUNNEY and W C ROSE. In continuation of the investigations in this laboratory regarding the nutritive importance of the amino acids, growth studies have been made with diets practically devoid of (a) arginine, and (b) arginin, glutamic acid, and aspartic acid The nitrogenous portion of each ration consisted of hydrolyzed casein from which the amino acids in question had been precipitated by appropriate methods White rats have been maintained for periods of 100 days upon food mixtures containing the modified casein at levels of 12 and 9 per cent., respectively During these periods excellent growth occurred. Animals which were furnished the 12 per cent rations grew at a perfectly normal speed, while those which received the 9 per cent. diets increased in weight at a slightly subnormal rate. That the less rapid growth under the latter circumstance was not due to a deficiency of arginine, glutamic acid or aspartic acid is shown by the fact that the incorporation in the diets of the amino acids in question entirely failed to accelerate growth. The above results point very strongly to the conclusion that arginine, glutamic acid and

aspartic acid are probably not indispensable for normal nutrition. On the other hand, this fact does not exclude the possibility that some other component of the protein molecule may assume vicariously the functions of the missing amino acids. The chemical similarity of proline, glutamic acid, and the ornithine portion of arginine suggests that these three compounds may be closely associated physiologically, or even interchangeable in metabolism. This possibility is being investigated.

Relationship between the structure and bactericidal properties to B Leprae of certain organic acids: ROGER ADAMS and associates (introduced by W. A. Noyes)

Power series expansions in the neighborhood of a point on a surface: ERNEST P. LANE. In ordinary space an analytic non-ruled surface referred to its asymptotics may be defined, except for a projective transformation, by a completely integrable system of partial differential equations in Fubini's canonical form

$$x_{uu} = px + \theta_u x_u + \beta x_v, \quad x_{vv} = qx + \gamma x_u + \theta_v x_v, \quad \theta = \log(\beta\gamma)$$

The four homogeneous coordinates of a point on such a surface referred to the covariant tetrahedron x, x_u, x_v, x_{uv}, with suitably chosen unit point, are such that, if the ratios of the first three of them to the fourth are denoted by x, y, z, there exists an expansion of the form

$$z = xy - \tfrac{1}{3}(x^3 + y^3) + \cdots$$

This paper presents a new method for calculating the coefficients of this expansion to as many terms as desired, and computes for the first time the coefficients of the terms of the fifth order. Then various geometrical applications are made. Since every term of the series is an absolute invariant it is easy to show how to write the equations of many curves and surfaces covariantly connected with the original surface and the geometrical nature of this connection is explained. In particular the algebraic surface of order n obtained by truncating the series after degree n, which is a generalization of the canonical quadrics and cubic surfaces used by Wilczynski, Green and Fubini, is characterized geometrically.

Groups generated by two operators of order three, the cube of whose product is invariant: G. A. MILLER.

Non-monogenic functions (by title): EDWARD KASNER.

Multiply transitive groups of prime power degree: R. D. CARMICHAEL (introduced by G. A. Miller)

On a property of frequency distributions of the powers and roots of variates of a given distribution: H. L. RIETZ (introduced by G. A. Miller)

Geometric properties of triple systems: A. EMCH (introduced by G. A. Miller)

On the theory of ideals in an algebra of finite order: G. A. WAHLIN (introduced by G. A. Miller)

Light quanta and interference: A. J. DEMPSTER. The reconciliation of the interference of light with the quantum theory of atomic processes leads to great difficulties. Hitherto no experiments have been made in which the light from a single atomic emission was examined. In this paper interference experiments are described in which only one atom at a time was excited. Interference patterns were observed just as when the light is produced by many atoms radiating at the same time, showing that a single light quantum follows the classical laws of division at a half silvered mirror and of subsequent recombination with the phase difference required by the wave theory of light.

The structure of atoms as a periodic function and its relation to ion-formation and valence: ARTHUR A. NOYES.

X-ray methods and results in the examination of fibrous materials, particularly asbestos: GEORGE L. CLARK. (1) Typical X-ray diffraction patterns are presented for the following fiber crystalline materials: natural cellulose, regenerated cellulose (rayon), silk, cobwebs, wood, stretched rubber, balata and gutta-percha, γ polyoxymethylene (methyl ether), worked grease, drawn and rolled metals, and 7 varieties of asbestos. (2) A new modification of the monochromatic pinhole diffraction method is exemplified for the case of chrysotile asbestos. (3) The method of calculating the identity period in the direction to the fiber axis is shown to be entirely independent of any assumptions concerning crystallographic system or arrangement of atoms and molecules in the unit crystal cell. (4) The practical significance of fibering in terms of behavior is indicated, with particular reference to the use of the X-ray method in testing, specification and research. The patterns for the varieties of asbestos are correlated with action of acids, heat and most desirable properties when used as catalyst base (contact sulfuric acid process), Gooch filter, brake bands, etc.

Surfaces: W. D. HARKINS.

The photochemical decomposition of hydrogen-iodide, the mode of optical dissociation: BERNARD LEWIS (introduced by W. A. Noyes). The photochemical decomposition of hydrogen iodide was studied at low gas pressures where the collision frequency is comparable with the mean life of the excited state. The quantum efficiency of the process was found to be about two, which agrees with Warburg's value for high gas pressures. This indicates that hydrogen-iodide dissociates in an elementary act as a result of absorption of radiation without the necessity of a collision. From the continuous absorption spectrum it is shown that dissociation takes place into a normal hydrogen atom and an excited iodine atom in the $2p_2$ state, the excess energy, if any, being dissipated as kinetic energy. It is pointed out that the time between absorption and dissociation is shorter than 2×10^{-8} second.

The volcano problem: ARTHUR L. DAY, of the Geophysical Laboratory, Carnegie Institution, Washington.

(To be continued)

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SPECIALIZATION AND COOPERATION IN SCIENTIFIC RESEARCH[1]

The three great functions of a university are to train young people in the art of living, to guide them in the search for truth and actually to engage in the pursuit of truth The first two of these are universally agreed upon and endorsed, but not so universal and whole-hearted is the recognition of the third—the research function of an institution of higher learning In some quarters the research aspirations of a university meet with distinct disapproval as encroaching upon the supposedly more serious business of the institution In other quarters they are viewed with grudging or amused tolerance as harmless little idiosyncrasies in which scholarly men must be indulged in order to keep them contented and out of mischief In the more enlightened quarters, however, it is realized that a university can not best perform any of its functions or measure up to its opportunities unless full and ungrudging support is given to its attempts to advance human knowledge

In such a gathering as this I need make no defense of research as a valuable and legitimate activity of a university It may not be out of place, however, briefly to review some of the considerations which are involved These naturally fall under three heads, of which the first is

I *Advantage to the student* If ability to think clearly and independently, to organize all his available mental resources, to direct his best efforts for the purpose of solving problems and meeting difficult situations is a thing worth gaining, then research is an important part of a student's training For the carrying on of research and its success depend on the degree to which these qualities of the mind can be focused on the problem. And what qualities of the mind are more important to develop than these? They can not be developed by that woefully overdone method of teaching by the easier process of fact-cramming To learn a thing one must do it To develop these mental traits they must be exercised. And the exercise of these mental traits, focused on some problem, *is* research.

Another advantage of research to the student is to be found in its stimulation of his interest. Nowadays people are not interested in things static, they

[1] Address delivered at the Founder's Day Exercises, Lehigh University, on October 5, by Professor K. T. Compton, Princeton University.

must be moving ahead. Our age is looking forward, not backward. For this reason we teachers find our students lukewarm or rebellious if confronted with the prospect of a long, long study of facts, laws and events for their own sake, without any immediate objective. But if we can put the student on his mettle by arousing his curiosity or interest in something into which he feels that he can put his creative and critical personality, it is rare indeed that he fails to respond.

I was at one time on the faculty of a small new college in the far west. Here not only was every graduating senior supposed to present a thesis embodying some original research in the field of his major subject of study, but class study itself was largely built around the idea of original investigation. I have never been in such an atmosphere of undergraduate intellectual activity Real study was not neglected but stimulated The objects of this undergraduate research were, of course, of various values But whether it was sleeping, eating and talking with the army of the unemployed in the old Billy Sunday tabernacle in order to investigate the causes of their economic troubles or whether it was attempting to predict the weather from observations of wind, barometer and length of a horse hair, it *did* lead to eager study and independent judgment, and it led a very large proportion of the students into post-graduate study

A few days ago I was talking with a chemist who told me how he happened to take up the study of sugars and other carbohydrates During his senior year he decided to go on with post-graduate study, but did not know exactly what he wanted to do. He was just generally interested in science His professor of physics had asked him to assist in some research work on the solubility of a certain kind of sugar by testing its purity by the well-known method of measuring its power to rotate the plane of polarization of light In doing so he noticed that he obtained a variable result depending on whether he measured this effect immediately after dissolving the sugar or waited some time before making the measurements. The professor then suggested that the further investigation of this phenomenon might be a good thing to follow up. His professor of chemistry, on the other hand, pooh-poohed such a project as trivial and almost certain to be principally a waste of time He urged this student to take a good advanced text-book of organic chemistry and, starting at its beginning, go right through it and actually make a sample of every organic substance whose method of preparation was described In this way, correctly argued the professor, he would become a skillful and learned chemist.

Now the investigation proposed by the physics professor *might* have been of trivial importance, but the idea of doing something new appealed so strongly to the student that he chose to try it. The result of this work was a fundamental discovery regarding the nature of sugar which has opened up a life's work for this man, made him one of the three world's authorities in this field, and shows promise of throwing light on some of the obscure phenomena of digestion and metabolism.

The second consideration to which I would call attention is

II. *Advantage to the teacher* Of course anything which benefits the student is at the same time an advantage to the teacher The preceding remarks may therefore be considered as applying also under this heading. In addition I would call attention to the pedagogical value of research in maintaining the enthusiasm, confidence and prestige of the teacher. Concerning his enthusiasm and confidence nothing need be said, for it is obvious that a man possesses these qualities especially in regard to a subject to which he himself is contributing If you wish to learn something about houses, talk to a man who is building one; if you wish to learn something about textiles, talk to a textile manufacturer, or his shop foreman, not to a clerk who is paid to sell textiles over the counter and who knows just enough to answer the questions usually asked by customers, if you wish to know some field of knowledge, go to a man who is contributing to it.

As regards the prestige of a teacher, his general standing in the community and the regard in which he is held by his students much might be said, but I shall make only one suggestion. It is well known that the general prestige of a university professor in Europe is far above that in this country. Der Herr Professor Geheimrat is a power in the country and an ideal to his students, most of whom would give anything to become such as he How many of our students envy us our positions? Not so many, I fear. To what is the difference due? I would suggest two elements of the situation which appear to me to deserve consideration.

In the tremendously rapid development of our country we have always had room for expansion and had at our disposal vast untouched natural resources from which to draw. Consequently great industries have been based upon exploitation of these resources and the whole tenor of our business life is permeated with the idea of success to the pusher—to the aggressive, quick-witted and perhaps not too scrupulous fellow who knows a good thing when he sees it. The American idol has been success, meaning usually business success. There are thousands who have

attained this success by our so-called keen business methods to one who has attained it through scholarly intellectual effort—and our country is still young and undeveloped enough to stand it.

In the older countries, however, equilibrium has been reached The natural resources are limited and their conservation is a momentous question Competition is keener It is universally recognized that the economic outlook is dependent on the wisest (not the fastest) utilization of resources. Hence the whole industrial structure is far more dependent on research than is the case in this country, and the value of research is correspondingly more universally recognized So the university professor, who there is preeminently a research man and trainer of research men, is recognized as an invaluable asset to the community

I believe that a second element in the situation is the very rapid growth of the schools in this country It has been impossible to train teachers or increase budgets rapidly enough to keep pace with the demand Consequently the average fitness of both our teachers and our methods leaves much to be desired I do not wish to decry our school system, for it has developed magnificently considering the magnitude of the difficulties to be overcome. But I believe that the consensus of opinion among those who have studied the situation (as opposed to the popular conception) is undoubtedly that, as regards *quality,* the education in a number of the European countries is distinctly superior to ours. And if we fail to demand and bring out the best in our students, we fail to the same degree to earn their respect and that of the community

Now, in the field of higher education, the fundamental difference between our usual methods of education and those in vogue in the European countries to which I have referred is found in the degree of independence and responsibility expected of the student Here we have too largely carried over the secondary school methods of mass production, involving frequent tests, marks and examinations, careful assignments of blocked out lessons, adherence to textbooks, supervision of attendance and study. There the student is set to master a subject. How or when he does it, whether through the aid of the professor's lectures or not, is not of much consequence. The big requirement is that he pass a comprehensive examination at the end. He knows that if he fails it is his own fault, and also that the choice positions in professional and government service will go to those who pass with highest distinction. He has therefore the incentive to exert every effort, and he must do it to a large extent independently. This independence of study, which culminates in research, inevitably leads to respect for the men who have contributed to the subject which he studies. The professor is thus a guide and example rather than a taskmaster or tutor.

As evidence of the truth of these remarks and as a hopeful sign for the future I may call attention to the increasing tendency in the colleges of this country to increase both the excellence of achievement expected of the student and the amount of freedom and responsibility accorded him in his endeavor to attain it This movement is usually undertaken somewhat timorously and in small steps, but I have yet to hear of a place where it has been tried and has not met with marked success and approval both by students and faculty. I am therefore firmly convinced that, in the field of higher education, we have greatly overestimated the importance of pedagogical systems and have greatly underestimated the possibilities inherent in a mutual relation of student and professor as common searchers for the truth.

In this brief analysis of the importance of research, my third heading is

III *Advantage to the community.* Inventors in this country have always been popular idols. We tell young school children about the inventions of Robert Fulton, Eli Whitney and Thomas Edison. We have been blessed by a number of men who had the spark of genius to conceive of a steamboat, a cotton gin, a dynamo or an incandescent lamp and numerous other machines and processes on which so much of life to-day depends. Nothing in the world is so potent with possibilities as a new idea, and really new ideas are rare and the product of genius. (Not all inventions are of this class Though I occasionally enjoy Life Saver candies, I do not believe that the invention of the hole in the candy deserved the reputed reward of a million dollars, or that the invention of a blue stripe on kitchen utensils should establish a man in either Wall Street or the Hall of Fame.)

As I have said, we have always lauded the inventor. But both behind and in front of the inventor is the true research worker The research worker first makes a fundamental discovery, then he proceeds to investigate it in all its aspects and attempts to explain it in its relations with other known phenomena. Next the inventor sees some way of turning this discovery to some practical account—and *this* is the step ordinarily called invention. Finally other research men investigate ways in which this practical application of the discovery may be made most efficient and effective Who, in this chain of activities, deserves the credit? The patent and the right to financial rewards go to the inventor, and I should be the last to try to belittle the value of his work. My plea, however, is for greater realization of the fundamental

and indispensable character of real scientific research, both as prerequisite to inventions and as essential to their perfection

Permit me to give one or two illustrations, which I choose from my own field of science, though I realize that equally striking illustrations could be drawn from other fields by those familiar with them

Back in the seventeenth century a number of French, English and Italian scientists investigated a newly-discovered phenomenon, which was that air in the neighborhood of hot objects was not a good insulator but could conduct feeble electric currents The phenomenon appears to have attracted no further interest until Guthrie, in 1853, showed that a red hot iron ball, suspended in air, could retain a charge of positive electricity but not one of negative electricity About thirty years later two Germans, Elster and Geitel, again took up a study of this phenomenon and with characteristic German thoroughness, investigated the electric currents obtained in all kinds of gases in the neighborhood of a variety of heated metal wires. Then Edison found similar currents of electricity flowing from the filaments of his newly invented carbon filament lamps into the surrounding partially vacuous space These and numerous similar investigations led to no satisfactory explanation of the phenomenon

But, about this time, the discovery of X-rays by Roentgen, of radioactivity by Becquerel and the researches of Sir Wm. Crookes led to the discovery of electrons and largely at the hands of Sir J J. Thomson and his pupils there was developed a coherent theory capable of explaining the known facts of electric discharges in gases and of predicting many new phenomena hitherto unsuspected. Among other things, Thomson showed that the electrical conductivity of gases in the neighorhood of hot wires is due to electrons which are emitted from the wires, and that this emission occurs even in the best vacuum Then one of Thomson's most brilliant pupils, O W Richardson, developed a theory to explain this emission of electrons and, in a remarkable series of investigations carried on partly in England and partly at Princeton University, he arrived at a very good understanding of the various factors which control this emission of electricity from hot bodies. As far as I have been able to verify the matter, every investigator who had made an important contribution to the discovery and study of the phenomenon up to this point had been a university professor or his pupil, with the single exception of Edison.

Now the story of how this was put to practical use has been the subject of much patent litigation and there were doubtless a number of nearly simultaneous steps in the matter As I heard the story it is as follows, which, if not exactly true in detail, is certainly true in principle. Richardson delivered a lecture before an Electrical Engineering Society. At the close of the lecture an electrical engineer came up to him with a pencil sketch on the back of an envelope and asked whether the filament and metal electrodes in a glass bulb, there shown, would not function as an electric valve, to permit electric current to flow in only one direction. This suggestion was an invention, the forerunner of all our radio tubes, certain types of battery chargers, important links in long distance telephony, special furnaces for careful metallurgical processes, and modern X-ray apparatus Now there are literally thousands of men engaged in research on this subject, which has drawn on the engineer, physicist, mathematician, chemist, geologist, biologist and physician The importance to our civilization of the modern means of communication made possible by this work can scarcely be conceived

I have gone into this example in some detail Some other illustrations I have time only to suggest Their development has gone through the same general stages as in the case just discussed.

The entire industry of electrochemistry is built upon the discoveries of Faraday, a professor at the Royal Institution

Joseph Henry, first a teacher in a boys' school, then professor of physics at Princeton, constructed the first real electromagnet, the first telegraph and printing telegraph, had a wireless set with which his family used to call him from the laboratory to his meals and, most important of all, discovered, jointly with Faraday, the laws of electromagnetic induction which underlie all electric power machinery. And when urged by his friends to press his claims for patent rights he answered that his scientific work was too important to be hampered by attending to such trivial matters.

In the electric light industry, the single discovery of a method to make tungsten wire, which involved some years of painstaking and disheartening research, is conservatively estimated to save the American public $1,000,000,000 per year in electric light bills.

Of course not all our industrial life is dependent to the same extent on research At the head of the list I would place such industries as the Bell Telephone Company, the radio companies and great chemical firms such as Du Ponts. At the bottom of the list would come those based on exploitation of natural resources, such as coal, steel, lumber and farming Yet in all these the time is rapidly approaching when research will become of predominating importance in enabling the industries to meet the demands made upon them. An interesting example of

this is found in the oil industry. Just after the war two young university instructors conceived the idea of utilizing certain well-known laboratory instruments and methods for the location of oil fields. They made some tests to prove its feasibility and talked about taking out a patent, but, being inexperienced, decided first to consult a prominent oil geologist He expressed interest and approval of their method, but discouraged them by saying that oil geologists now know all that this method could give in regard to oil location, so that such a device would be quite superfluous So they dropped the matter Now, less than ten years later, this very method is in use together with several other applications of laboratory devices The oil companies are obtaining an astonishing record of "strikes" by their use and are vieing with each other to secure properly trained men and equipment to beat their competitors in the survey of new fields

If we turn to biological and medical science, we come to a field which is almost free from industrial exploitation, but which is even more fundamentally important than are the physical sciences to human welfare In these fields the only possible advance comes through research, and research is done almost exclusively in such altruistic institutions as universities, hospitals and foundations such as the Rockefeller Institute

These illustrations bring out with striking emphasis three facts (1) Inventions were preceded and followed by a very great amount of research work (2) The research work which paved the way for the inventions was carried out almost exclusively in universities (3) The entire body of work has resulted in the establishment of large industries and in inestimable opportunity and profit to humanity

Let me in another way emphasize our debt to research. Sociologists have pointed out the important part played by slavery in the development of civilization It was only when the ablest men's routine work was done by slaves, giving them leisure time to think, that those ideas were evolved which resulted in the physical and spiritual uplift of the race To-day it is estimated that our practical applications of scientific discoveries have a producing power equal to sixty slaves for every man, woman and child Compare, then, our present life with that of our primitive ancestors, and you have a vision of our direct and indirect debt to research

Let us turn now to some practical aspects of the situation which have a bearing on our attitude toward research in the future I wish very briefly to call attention to four conclusions which seem to be certainly justified by past experience. The first of these is that:

I. *Research must be more generally encouraged and supported.* You may have thought, in my illustrations of the advantages which have been derived from research, that I gave undue emphasis to invention and commercial development. I did so purposely, for I wished to bring out a contrast. Where immediate financial returns are in sight, the keen search for profits which spurs our business life brings quick support and reward Thus industrial research and development are coming more and more to be looked upon as shrewd business policy Purely scientific research, which is absolutely prerequisite and basic to invention and development, is, on the other hand, generally carried on at a personal sacrifice and cramped for facilities. The average scientist has to battle against the odds of other supposedly prior duties in order to get time for concentrated thought and sustained experimental effort. How short-sighted is this policy, which starves the roots of our future progress! Yet it is easily understood The results of purely scientific inquiry are uncertain. There are many trivial steps for one great stride in advance, and there is no foretelling in which direction this stride will be No ordinary business organization which has its vision fixed on the profits of the next few years can, as a selfish business proposition, support pure and independent scientific inquiry, because the chances of a return within this time and in the range of its interests are too remote A few only of the big industries do support pure research from altruistic motives because they are able and willing to return to pure science a little in return for the benefits derived from it, or they may support it because their interests are so varied that they can justify taking a chance on some discovery that can be turned to profit, or they may support it for reasons of publicity and personnel Whence, then, is support for scientific research to be obtained?

In the first place this support should come from those same funds which support the other activities of our universities, on the ground that research is an essential element and method of education. In the second place it will come from altruistic citizens and organizations who possess the wisdom and imagination to visualize the possibilities which research will uncover for the future. In the third place, as I have suggested, it should come from industrial and business organizations. I should like to see all such enterprises which profit directly from the work of science taxed to support research Probably this can never be done by legal means, but its equivalent may be brought about by publicity and the force of enlightened public opinion. If, for example, a large proportion of such industries could be induced to share the burden of supporting research and this were done on a large scale, no one industry would be handicapped in re-

spect to the others and from the widespread nature of the research thus made possible, every industry would have a reasonable expectation of obtaining something to its direct advantage in addition to the indirect benefit of general business stimulation Such is the justification of the "Hoover Fund" which the National Academy of Sciences is attempting to raise from large industries with the strong backing of Secretary Hoover Finally, support may come from the government, if this can rise above the pressure of political struggle and popular appeal for tax reduction, and look to the welfare of the future True, the government is now supporting a few research agencies, but on a very niggardly scale, in very restricted fields, and with such pressure for immediate practical returns as to drive out those scientists who might do big things and almost to kill the possibility of that type of research which might have great consequences

It has been said that civilization is measured by the degree to which the people will sacrifice present desires for the sake of future benefits On this basis the degree to which we support research should count heavily in estimating our degree of civilization

The second conclusion which I would draw is that:

II *The universities must be the chief agents and mainsprings of research* There is no organization other than the universities where there are gathered together the men of scholarly training capable of carrying on research in the whole field of scientific inquiry If there *were* some other suitable organization, it is there, rather than to the universities, that young men would go for research training, and this organization would at once *become* a university Such work is undoubtedly the function of the universities.

Furthermore, it is a well-known paradox that the discoveries which have led to the greatest practical results have not been made by the men who were seeking the practical results. The reason for this is plain. The man who is seeking a certain end is mentally circumscribed by the methods which are already known for attaining this end He may perfect some previous process, or he may see how to apply some phenomenon or principle which has not hitherto been applied, but his mental state handicaps him in discovering anything fundamentally new The basic research must, therefore, be a free and unfettered search for truth It is the universities alone which can offer any considerable opportunity for such endeavor

Besides this, it is to the universities that the industrial laboratories and government bureaus must turn for their trained men. The head of one of the largest electrical companies recently stated that the only limitation to the development and extension of his industry lay in the dearth of trained men fitted to take charge of the developments which they had in sight.

The third lesson I would draw from the experience of the past is that:

III *Research must proceed by specialization.* Research has always required concentration, but it did not formerly require intense specialization Look, for instance, at Benjamin Franklin, at once philosopher, publisher, scientist and diplomat. Even in science he did not specialize To quote from an admirable address by Dr Little before the Franklin Institute:

> Among all the activities with which his busy life was crowded, Franklin undoubtedly found his greatest interest in the pursuit of science . At a time when nearly everything was awaiting explanation, his focused attention ranged like a searchlight over many fields. He observed the movement of winds and developed a theory of storms He considered ventilation and the causes of smoky chimneys and proceeded to invent new stoves He introduced the Gulf Stream to Falmouth skippers and demonstrated the calming effect of oil on turbulent seas to officers of the British Navy at Portsmouth From earthquakes he turned to the heat absorption of colored cloths and the fertilizing properties of gypsum. He wrote on sun spots and meteors, waterspouts, tides and sound The kite, which for centuries had been the toy of boys, became in Franklin's hands a scientific instrument, the means to a great discovery That its significance is, even now, not universally appreciated is shown by the recent answer of a school boy, "Lightning differs from electricity because you don't have to pay for lightning" To Franklin . we owe our initial conceptions of positive and negative electricity, and he was the first to suggest that the aurora is an electrical phenomenon.

But to-day each individual branch of science is larger than the entire body of science of Franklin's day The philosopher may still contemplate the entire field of knowledge and consider its interrelationships, but no man can do creative work in the entire field. Some especially gifted men can leave the imprint of their genius in a larger variety of directions than the majority of us, but the bulk of the research of the future seems destined more and more to be carried out by people who are highly trained in specialized fields.

With this tendency comes the necessity of a balancing movement, which is my last conclusion:

IV. *Research must become more and more cooperative* An obvious handicap and danger of specialization is that a man may not know, and in fact now-a-days can not know, even all the aspects and relationships of his own special field, however small Hence, unaided, he becomes helpless through the very specialization which he hoped would give him power. The remedy for this danger lies in cooperation between workers in closely related branches of study.

Just as in the process of organic evolution we find increasing specialization accompanied by increasing interdependence, just as the growth of highly specialized industries has necessitated careful attention to their coordination, just so the increasing specialization in research makes necessary an increasing degree of contact and mutual assistance between scientists.

To take just one example Though physics is the most mathematical of the sciences, the average research physicist and the average productive mathematician speak languages unknown to each other To make advances in one field available for progress in the other there has arisen a chain of connecting links We have the experimental physicist, the theoretical physicist, the mathematical physicist, the applied mathematician and the pure mathematician I do not believe there is a single living scientist who could at the same time classify under all six headings There is possibly one, named Einstein, who might classify under five, and there are very few who could classify in four of these groups

How can this essential cooperation best be brought about? Certainly no single formula will serve to solve the whole problem, and no solution will be easy because research, to be effective, must be independent as well as coordinated, and these are two almost antagonistic features Several solutions may, however, be suggested as of proven value and worthy of encouragement.

One of these is the encouragement of research in the so-called border-line fields such as mathematical physics, physical chemistry, biophysics, biochemistry, etc Not only are such coordinating studies necessary, but they are, in my opinion, the most fruitful fields of investigation Nature herself is not divided into a physical world, a chemical world, a biological world, she is a unit. These artificial distinctions have been introduced for convenience and because of our inability to see the whole field at once They have resulted in rapid development in the particular direction and by the particular method of each of the sciences, whereas work in the border-line fields has lagged behind. It is as if the whole field of knowledge were originally a desert When the rain fell on this desert, the water flowed off in streams and rivulets, each digging its channel deeper and deeper but leaving the intervening space relatively untouched. The best place to dig is now in these intervening spaces

The necessity of coordinating border-line work is recognized by such far-sighted organizations as the General and International Education Boards and the Rockefeller Foundation which have, for example, supported the great system of National and International Research Fellowships, one of whose guiding principles is the stimulation of research in the border-line fields. In our universities further facility and encouragement should be given to men to prepare for work in these directions.

Another solution can advantageously be advanced by wise administration of the universities. There seems to be a wide-spread, but ill founded, feeling that all departments of a university should be developed together and kept closely abreast. Perhaps this relieves the administration from embarrassment, but I venture to suggest (though the suggestion is not new) that this is not sound educational policy except for an ideal institution which has unlimited resources. Such a policy dissipates effort, and if every institution followed it we should have the spectacle of a great many universities all very much alike and all with struggling, mediocre departments Much more effective in advancing knowledge as well as in bringing distinction to the university is the policy of supporting to the available limit certain departments selected because of their already outstanding character, or because of the traditions and purposes of the university, or for any other reason If these favored departments are chosen in a coordinated group, then the university becomes an active center for the development of that field and the promotion of cooperative effort For example, one institution may choose to give *particular* facilities for advanced work in classics and languages, another in historical, economic and social sciences, another to physical and biological sciences, etc If we were to examine the record of those universities of limited endowment which have nevertheless been preeminent in the life of the country, we should find that they attained this preeminence through concentration of effort The words "To him that hath shall be given" apply here as well as elsewhere.

Through concentration of effort in a coordinated group of departments, a university has the opportunity not only to correct the dangers of over-specialization, but also to take a strategic position in fulfilling its obligations to society

Much can also be done to promote cooperation and coordination through actual methods of organization. This has been strikingly demonstrated in some of the big industrial research laboratories, from which the output has greatly exceeded the individual capacities of the research workers and has been achieved only by coordination of effort. Such organization requires a very wise and far-visioned director who can visualize the big objectives and steer through the mass of petty details which must be worked out in order to attain them.

In a university, where the number of workers is much smaller than in a big industrial laboratory, such army-like organization does not appear feasible or probably desirable. Much is being done voluntarily by scientists themselves in dividing up particular

fields for cooperative investigation, and this is being fostered by research committees of organizations like the National Research Council However, there is another direction in which more effective organization is possible within the universities themselves!

Departments of a somewhat more flexible nature than those to which we are accustomed and which could, more than now, be built around one or two outstanding men in the department, could give these men an opportunity for organization and concentration of effort which is now rarely possible This would, of course, require careful selection of men In this matter of organization of departments around the most productive and outstanding men, of taking for granted that they will have research assistants to increase the efficiency of their labors, of selection and recognition of men on the basis of merit and promise rather than seniority, and of wise procedure in the selection of men to fill important posts, America is far more backward and bound by tradition than are those European countries in which scientific achievements have been most rapid It may surprise you, for instance, as it did me, to learn that in America, the land of wealth and opportunity, there is no university which is able to offer a salary equal dollar for dollar to salaries which universities even in war-ridden Germany will offer to secure the outstanding men As is the tendency in other things American, our tendency to standardize, which is so useful in some directions, is interfering with our ability to recognize, secure and do our best This situation in our universities is, I believe, a grave one if we set as our ideal the best possible achievement.

In these remarks I have attempted to suggest some of the accomplishments and opportunities of research and to indicate some of the directions in which we may hope to bring about even more fruitful service of science to society in the future

This, gentlemen, is the situation. It is a situation that calls for serious thought and constructive action The things which I have been able to say are not new, but I sincerely hope that you may find in them reasons sufficient to enlist your sympathy and active support of any movement which has for its purpose the better service of science to our country and to humanity

KARL T. COMPTON

PRINCETON UNIVERSITY

SOME PROBLEMS IN BOTANICAL CLASSIFICATION[1]

THE systematic botanist (or taxonomist as he is often called) has a double duty First, he must give each apparently new plant a name which other workers in plant science may use in describing their experiments with the plant or in drawing conclusions regarding plant distribution and so on This name must designate the plant's relationships with approximate accuracy and is based on a close study of gross morphological characters. By that I mean such characteristics as shape of leaves, color of flower, number of flower parts and their arrangement—in fact such physical properties, to use a chemical phrase, as can be determined fairly readily with the naked eye or by aid of a small lens. The degree of resemblance of the total of these characters, and especially as regards those of the flower and fruit, between plants has served as the criterion in judging the degree of relationship of the plants This type of taxonomic work will probably always be based on the same method It is worth noting here that there still are enormous areas of the earth's surface, the vegetation of which remains comparatively unknown despite the flood of taxonomic publications during nearly two centuries, and these areas offer an attractive field for what I may call this "preliminary naming"

Second, he must revise his conceptions of plant groups in accordance with the progress of work in other botanical fields and such discoveries as are constantly being made that tend to show more clearly the exact relationships of the plants involved

Of chief interest to us is this second phase—namely, the correlation of taxonomic work with other botanical work and the revision of opinions that necessarily results from many-sided, intensive investigations (The preliminary naming of the cultivated fruits and vegetables of the north temperate zone has long since been completed) Taxonomists have perhaps been a little slow in the utilization of other workers' results, but the last decade has seen started a considerable number of new lines of systematic investigation based on the work of plant physiologists and chemists, geneticists and cytologists

It is, I believe, the correlation between the work of the geneticist and cytologist and that of the systematic botanist that offers the most promising line of attack on the age-old problem of clearing up the relationships of cultivated plants. This problem is of vital interest to us at this station.

In the Division of Horticulture, we have been particularly interested in fruits and vegetables, and, at present, some typical questions of considerable moment are: What are the true species of apple—or, in other words· What are the fairly stable natural groups of the genus Malus? What species are we working with in our attempt to breed better fruits? What are the characteristics of each of these entities? As you may readily perceive, the answers to these

[1] Extract of address before the June staff meeting of the New York State Agricultural Experiment Station, Geneva, N Y, June 6, 1927

questions are fundamental to a clear portrayal of breeding problems, and if these answers can be made with some degree of completeness, the formulation of breeding experiments with apples will proceed with greater facility and with increased probability of reaching favorable results. The same questions may be asked in regard to each group of cultivated plants and will have the same bearing on experimental work with them

This taxonomic problem we are now attacking by a new method which has already shown promise in the case of the allied genus of Roses. The preliminary announcement of this work by Hurst just four years ago constitutes the first attempt to untangle a complex group of cultivated and wild forms by reference to cytological evidence

At this point it may elucidate the situation somewhat if I review briefly Hurst's discoveries in Roses

The inception of his work seems to have been more or less accidental He says that one day while comparing the taxonomic characters of certain species of roses at Kew, he was struck by the fact that a species he knew to have 28 chromosomes showed the combined characters of two distinct species having 14 chromosomes each, while one containing 42 chromosomes showed the combined characters of three distinct species of the smaller number of chromosomes, and one with 56 showed the combined character of four of the others

Further investigation of about 400 forms of Rosa have revealed 5 distinct species of 14 chromosomes each and have shown about 50 different taxonomic characters associated with each Hurst thinks there may result over 200 commutations and permutations of these characters, and he has identified a large number of these.

Now to consider some of the possibilities arising from the uniting of germ-cells of different constitution—that is, of those containing chromosomes of different make-up, or of different numbers It seems from such evidence as is at present available that a union of germ-cells will not take place if their constitution is too divergent However, it also seems patent that, provided the germ-cells are very largely similar in content, a union may take place even though the number of chromosomes differ. For example, germ-cells of a species of Rose containing 14 chromosomes will sometimes unite with germ-cells containing 21 chromosomes (of another species of Rose, manifestly). In the subsequent body or somatic division of cells (as has probably already suggested itself to you) the 35 chromosomes may not divide evenly, and certainly in reforming germ-cells there can be no even division of an odd number.

The plants which arise from such combinations of germ-cells and all their descendants naturally vary a great deal in their characteristics It is my personal belief that 99 per cent of the difficulties which confront both taxonomists and plant breeders are due to these plants whose exact constitution can not be predetermined nor indeed determined with at all complete accuracy by use of any of the older methods.

With the foregoing considerations in mind I started this spring to attempt to unravel the species of apple by aid of such cytological and genetic evidence as might be obtainable. Dr Bernhard Nebel, of Halle a S., kindly took upon himself the cytological work involved There has been almost no cytological work done on the so-called species or hybrids of Malus, nor indeed on apples at all, except for a few recent papers on the relation of chromosomes to fertility of pollen

It is too soon to speak with much confidence as to what has been found or as to what bearing these discoveries may have on the problem, and what I have to say now may upon careful study have to be modified considerably However, these seem to be the results and their significance at present

Several of the plants which I believe to be good species, that are fairly stable associations of genetically closely allied plants, show 14 chromosomes in the nucleus, others show 28 These plants also show nearly regular nuclear divisions This would seem to indicate that apples may show (as roses undoubtedly do) that good fundamental species will have either 7 or some multiple of 7 as the basic number of chromosomes Whenever we find, as in the case of *Malus Scheideckeri*, a variable number of chromosomes and very irregular division, I think we may assume that we are not dealing with a good species but with one of the variable types of hybrids Our work is not yet far enough along to discuss further results

It may be interesting, however, to point out some purely speculative possibilities

If 7 pairs of chromosomes is the fundamental number in apples, then there are probably several good species containing sets of 7 pairs each possessed of somewhat different characteristics A union of germ-cells between two such species might give rise to another good species and undoubtedly has done so Moreover, apple species of 21, 28, or 35 chromosomes may exist—according to one investigator—and combinations between these have probably produced other good and valid species *But* a combination between a species with 14 chromosomes and one with 21 might and probably has produced a very variable series of offspring

Just how far these possibilities may fit with the facts as shown by results of experimental work done on apples is now a part of the problem

I refer to "experimental work done" because for a number of years it will be necessary to utilize all of the data obtainable from experiments that have been tried with other aims in view This is due to the facts, first, that no attempts have as yet been made by geneticists to breed apple species for the specific purpose of determining their taxonomic position in relation to each other, and, second, that apples are so slow in maturing that it takes half a life time to get three generations Perhaps I should have put the statement the other way about and said that man lives so short a time that he can manage to see only 3 or 4 generations of apples in his life. Of course, these statements also apply, with more or less aptness, to other perennial fruit crops The vegetable crops offer a more satisfactory field in point of their shorter individual lives and greatly increased number of generations per given time These, too, we hope to investigate in the same way

This whole situation leads much farther than the naming of types of plants It promises, I believe, a tremendous advance in taxonomic accuracy for the very reason that it may give us a clear-cut definition of a species. Heretofore, a species has always been a concept and no two taxonomists have agreed entirely in their specific concepts. The more variation there is in a group of plants, the greater the diversity of concepts existing among specialists on that group. In cultivated plants, because of the tremendous variations induced by men by selection, crossing, and removal of natural competition and other difficulties in what might be called the "normal life struggle" of the plant, this diversity has been increased many fold The remarkable thing, it seems to me, is that there exists as much agreement in specific concepts as there is This new method seems to promise an approximation, at least, to mathematical accuracy. Given a definite number of pairs of chromosomes and a perfectly regular method of cell division allied with a distinct group of other morphological characteristics and we have a good species. Given an indefinite number of chromosomes and irregular division, we haven't a good species but a hybrid of sorts, characterized in every case investigated thus far by considerable variation in gross morphological characters.

If, as I have assumed, the greater part of the difficulties lie in the varying concepts regarding those plants which are not *good* species according to my definition of a moment ago, then a clarification of the status of those plants by reference to their cytological behavior will go a great ways in stabilizing nomenclature of plants in general. Perhaps, I should have said "higher plants," for I fear this investigation of chromosomes will be of little use to the bacteriologists who have yet to find such things in their whole category of delightful pests. However, the bacteriologists by their use of physiological reactions have gone further, I believe, in attaining accuracy in delimitation of related forms than the systematic botanists who deal with seed plants and trust to their eyes alone to determine differences and likenesses.

This may lead to some difficulties in terminology involving among other things the uses of such words as hybrid, cross, variety, form and species It seems to me that the term hybrid will have to be held merely for those results of crossing in which the ensuing nuclear divisions exhibit irregularity of behavior coupled with varying degrees of sterility And it is to be noted that so far as known at present some degree of sterility is *always* associated with this irregular chromosome behavior It seems likewise evident that when the result of a cross is an organism with perfectly regular nuclear division and complete potential fertility, it must be reckoned a good species regardless of whether it has been found wild or is known only under cultivation.

I believe I have exhausted my time and possibly your interest My own interest, I have to confess, is white hot. I feel that we are in view of some striking advances in taxonomic work and it is a rare pleasure to be in at the very beginning of the adventure

G P. VAN ESELTINE
AGRICULTURAL EXPERIMENT STATION,
GENEVA, N. Y.

SCIENTIFIC EVENTS

THE INTERNATIONAL CONGRESS OF ENTOMOLOGY

THE Fourth International Congress of Entomology is to be held in August, 1928, at Cornell University, Ithaca, N Y. Previous congresses have met at Brussels (1910), Oxford (1912) and Zurich (1925) Every important interest—educational, scientific and economic—will be provided for in the program. Invitations have been forwarded through the state department to foreign governments to send representatives and later invitations will also be sent to the individual entomologists. A program will be arranged in which some of the leading entomologists of the world will take part It is planned that in the forenoons throughout the week papers of general interest are to be read before all members of the Congress. In the afternoon sections will be formed dealing with (1) taxonomy, distribution and nomenclature; (2) morphology, physiology and genetics; (3) ecology; (4) medical and veterinary entomology; (5) economic entomology with its subdivisions relating to forest, fruit, vegetable and cereal insects, bees, insecticides

and appliances. According to the number of papers announced, each section may be subdivided or several sections may be united Time will be arranged for an all-day visit to the Geneva Experiment Station where the forenoon will be spent in looking at the exhibit of spraying machinery and insecticides, in examining the methods and machinery used in controlling the European corn borer, and in observing a demonstration of airplane dusting. The afternoon will be devoted to a general program. In addition, the summer meeting of the New York State Horticultural Society will be held at Geneva on the same day, which will serve to give the visiting foreign entomologists more ideas of the general interest of American farmers in entomology. Certain afternoon excursions will also be made to nearby places of entomological interest, while immediately after the meetings some general excursions are planned to Niagara Falls, to entomological museums of eastern cities, and to the laboratories of the U S Bureau of Entomology devoted to the study of the gipsy and browntail moths, the corn borer and the Japanese beetle.

THE WALTER RATHBONE BACON SCHOLARSHIP

Under the terms of the will of the late Virginia Purdy Bacon, of New York, the Smithsonian Institution receives a bequest to establish a traveling scholarship as a memorial to her husband, Walter Rathbone Bacon.

The secretary of the Smithsonian Institution has established rules which are to regulate the award of the Walter Rathbone Bacon scholarship for the study of the fauna of countries other than the United States of America. The amount available is the interest on the capital invested (about $3,000 a year), the incumbent to hold the scholarship not less than two years

Applications for this scholarship, addressed to the secretary of the Smithsonian Institution, should be submitted not later than January 1, 1928 The application should contain a detailed plan for the proposed study, including a statement as to the faunal problems involved; the reasons why it should be undertaken; the benefits that are expected to accrue; the length of time considered necessary for the carrying out of the project; the estimated cost, and the scientific and physical qualifications of the applicant to undertake the project

The scholarship will be awarded for a term of two years If at the expiration of the term it is desired to extend the time, the incumbent shall make application a sufficient time in advance, accompanied by a statement as to the necessity for such extension.

All collections, photographs, records and equipment become the property of the institution.

The incumbent shall not engage in work for remuneration or receive salary from other sources than the institution or its branches during the period of occupancy of the scholarship.

THE LINTHICUM FOUNDATION PRIZE

The faculty of law of Northwestern University, administering the income of the Charles C Linthicum Foundation, announces that the sum of one thousand dollars and a bronze medal, as a first prize, and two sums of one hundred dollars each, as second prizes, with honorable mention, will be awarded to the authors of the best essays or monographs submitted by March 1, 1929, on "Scientific Property," *i.e*, the extension of the patent or copyright laws so as to recognize a right, in the discoverer of a scientific principle, to some share of the profits that may accrue to an inventor who makes use of that discovery to devise an "art, machine, manufacture or composition of matter" (as the statute defines it) and thus obtains a patent. The law has hitherto not recognized such a right.

The subject of the award in 1927 was "The Law of Radio-Communication," and the prize was awarded, on June 16, 1927, to Stephen Davis, Esq, member of the bars of Oklahoma and New York, and formerly solicitor to the United States Department of Commerce

The present offer was originally opened only to members of the legal profession in the United States or Canada, but has now been enlarged to include all countries of the world

The award will first be made public in June, 1929, on the occasion of the annual meeting of the Alumni Association of the Law School.

Further information may be obtained by addressing the Linthicum Foundation, Northwestern University Law School, Chicago. The work submitted may be one already published in print at the time of submission. Manuscripts submitted must be typewritten on paper of size of legal cap or typewriter or commercial note, and in the English language A work submitted in French, German, Italian or Spanish may be examined, at the discretion of the faculty, but, if awarded the first prize, it must be translated into English for publication, at the expense of the author.

THE ENGINEERING INDEX SERVICE

Plans have been completed in a comprehensive scheme for indexing the engineering literature of the world, to be initiated the first of the year, with the new weekly engineering index service of the American Society of Mechanical Engineers.

This task is so extensive as to include the preparation of index items for the 1,500 technical publications

of the world appearing in 17 languages in 37 countries which are received in the Engineering Societies Library The index items will be printed on cards and mailed weekly to the subscribers to the new service This project was authorized by the American Society of Mechanical Engineers' council at its St. Louis meeting on October 8, 1927, as an important extension of the *Engineering Index* in its service to research and the development of industry and to bring to every one, not only in the United States but to any in the world, the storehouse of knowledge appearing in the technical literature of the world

The American Society of Mechanical Engineers has published the *Engineering Index* since 1919, when it was taken over from the *Engineering Magazine* During the eight years this book has been published by the society, its volume of material has increased from approximately 8,000 items annually to 16,000 These were first published monthly in *Mechanical Engineering* and at the end of the year collated in an annual volume In the limited scope of a book of this kind it is possible to give only an incomplete service, while the modern needs of industry demand complete information about published technical material throughout the world and require it promptly Accordingly, the new scheme was developed to meet this demand

This service is made possible by the cooperation of the library board of the United Engineering Society Library and, in addition to the augmented technical staff of the society, the especially trained group of librarians who have on file the magazines to be indexed and who are prepared to furnish photostat copies and translations of foreign articles to those requiring them

The new service will be under the general supervision of the committee on publications of the society, of which Ralph E Flanders is chairman, and the finance committee, under the chairmanship of H. V Coes. Professor Carlos deZafra, of New York University, will occupy the post of director of *The Engineering Index*

THE COMMISSION FOR RELIEF IN BELGIUM FELLOWSHIPS

THIRTY-THREE Belgian advanced and graduate students will study in America during the whole or a part of the year 1927–1928 as holders of fellowships under the auspices of the Commission for Relief in Belgium Educational Foundation, 42 Broadway, New York. Three American fellows are at present in Belgium for a full year of advanced work.

The distribution of fellows in the field of science and their subjects of post-graduate study are as follows:

Harvard University: in neurology, Dr Jacques De Busscher

Massachusetts Institute of Technology: in metallurgy, Marcel Allinckx; in electrical engineering, Leopold De Beer; in automotive engineering, Paul DePermentier; in hydraulic engineering, John L. Eeman; in aeronautics, Frits P Malschaert

Stanford University in electrical engineering, Carl L. DeBrouwer (honorary fellow), in economic geology, Robert DeStrycker, in geology, Joseph Donnay, in electrochemistry, Pierre van Rysselberge

University of California in physiology, Dr. Lucien Brouha, in chemistry, Yvonne Lieben; in bacteriology, Dr Jeanne Lommel

Columbia University in psychology, Dr Simone Ghisoland, in radio activity, Dr Suzanne Simon

Western Reserve University in pharmacology, Dr Corneille Heymans, in physiology, Dr Pierre Rijlant

Yale University in chemistry and hygiene, Dr Francois Schoofs; in embryology, Dr Ernest Van Campenhout

California Institute of Technology in physics, Willy Uyterhoeven

Carnegie Institute of Technology: in steel industry, Joseph DeWez

Cornell University in thermodynamics, Albert DeSmaele

Rockefeller Institute: in respiratory diseases, Dr Pierre Denys.

Special Investigations and Travel: in bacteriology, Professor Richard Bruynoghe, in Greek archeology, Hubert Philippart

The Americans in Belgium include Dr George Sauté, of Harvard University, in mathematics.

Each fellowship provides full traveling expenses, payment of tuition fees and a limited stipend for living expenses This fellowship exchange began in 1920 and, in all, 73 American and 218 Belgian fellows have been appointed The fellowships were established to commemorate the war-time relief work of the Commission for Relief in Belgium and to promote the exchange of intellectual ideas and good-will between Belgium and America.

SCIENTIFIC NOTES AND NEWS

DR. THOMAS BARBOUR, curator of reptiles and amphibians in the museum of comparative zoology at Harvard University, has been appointed director of the museum to succeed Dr Samuel Henshaw, who recently resigned after serving for twenty-three years

DR. GEORGE K BURGESS, director of the U. S Bureau of Standards, has returned from Paris, where he officially represented the United States at the Seventh International Conference on Weights and Measures.

DR. HAVEN EMERSON, professor of public health administration in the College of Physicians and Surgeons, Columbia University, is to give a series of lectures during the week of November 28 to Decem-

ber 3 in London, at the invitation of the health section of the League of Nations. The topics of his lectures will be, "Epidemiology in Non-communicable Diseases," "The American Program for the Prevention of Heart Disease" and "Diabetes Mortality from the Public Health Point of View"

On the occasion of the formal opening of the new medical school and clinics at the University of Chicago on October 31 the honorary degree of doctor of science was conferred upon Dr Frank Billings, emeritus professor of medicine in the university, Dr Rufus Cole, director of the hospital of the Rockefeller Institute, Dr William S Thayer, professor emeritus of medicine at the Johns Hopkins University, and Dr Karl Landsteiner, of the Rockefeller Institute

The International Urological Congress, meeting in Brussels, conferred upon Dr Edwin Beer, visiting surgeon at Bellevue Hospital, New York City, the first award of its gold medal for the introduction of a new method of curing bladder tumors by high frequency currents

The Baly medal of the Royal College of Physicians, England, was presented on October 18 to Dr A V. Hill, Foulerton professor of physiology at University College, London

The Compton medal of the Institution of Automobile Engineers has been awarded to H R Ricardo for his paper entitled "Some Notes on Petrol-Engine Development"

At the annual meeting of the Royal Society of Edinburgh, held on October 24, the following officers and members of council were elected *President*, Sir James Ewing, *General secretary*, Professor R A. Sampson; *Treasurer*, Dr J. Watt, *Curator of Library and Museum*, Professor D'Arcy W Thompson, *Councillors*, Professor G Barger, Mr J. Bartholomew, Professor C. G Darwin, Professor D Waterston, Mr J W Peck, Dr. J Ritchie, Professor R Stanfield, Dr A. L. Turner, Dr G W Tyrrell, Professor J H Ashworth, the Hon. Lord Constable, Professor E Taylor Jones

Sir William Larke, director of the National Federation of Iron and Steel Manufacturers, has been appointed a member of the advisory council to the committee of the Privy Council for Scientific and Industrial Research.

Professor A. L. Kroeber, chairman of the department of anthropology at the University of California, has been named faculty research lecturer for 1928 The faculty research lecturer is selected each year by a faculty committee from among those connected with the university who have contributed most to science during the previous year, or who have concluded some particularly interesting piece of work

Dr William Townsend Porter, professor of comparative physiology in the Harvard Medical School, has been made professor emeritus

H A Marmer, of the U S Coast and Geodetic Survey, has been appointed a member of the committee on tides of the International Geodetic and Geophysical Union

Dr. George Grant MacCurdy, of Yale University, has been chosen as one of the seven foreign patrons of the newly established Prehistoric Society of Morocco. Dr MacCurdy returned to New Haven in October after a summer in Europe directing the work of the American School of Prehistoric Research

John A. Comstock has been appointed acting director of the Los Angeles Museum and will serve in this capacity during the absence, in Europe, of William Alanson Bryan

George B Watkins has resigned his position as instructor of chemical engineering at the University of Michigan, to accept a position as chemical engineer in the research department of the Libbey-Owens Sheet Glass Company, Toledo, Ohio

Dr Clarence E. Kobuski has been appointed assistant at the Arnold Arboretum of Harvard University

Dr George E Brewer, professor emeritus of surgery at Columbia University, sailed from the United States on October 15 for Europe, where he expects to spend the year in anthropological study

Dr. Immanuel Friedlander, director of the Vulcanological Laboratory at Naples, Italy, is visiting the United States.

Dr. David Linder, instructor of botany in Washington University and mycologist to the Missouri Botanical Garden, after a year's leave of absence in Africa, has returned to this country and has taken up his work in Washington University and the garden.

Dr Leopold Henry, director of the Central Electrique des Flanders at Langerbrugge, and Dr I J. Moltkehansen, well-known Norwegian electrometallurgist, and Consul Honaire de France, Brussels, who accompanied the American Electrochemical Society on its industrial trip through the Northwest and later visited many important universities and research laboratories in the East, have sailed for Belgium.

Dr. Felix Deutsch, head of the Allgemeine Elektrizitäts-Gesellschaft, sailed for home on November 2, following a short visit to the United States.

DR. SVEN INGVAR, docent in neurology at the University of Lund, Sweden, gave three lectures on the Herter Foundation at the Johns Hopkins University on November 3, 4 and 5 His subjects were "The Cerebellum its Structure and Function" and "Pathogenesis of Argyll-Robertson Phenomenon"

DR. RAOUL BLANCHARD, professor of geography at the University of Grenoble, offered a series of lectures on "Human Geography of High Mountains" and a series on "Urban Geography" at the school of geography in Clark University during the month of October Dr C F. Marbut, director of the U. S Bureau of Soils, is at present lecturing at the school on the "Origin and Development of Soils in the United States" Dr Frederick Starr, professor emeritus of anthropology at the University of Chicago, will give a series of four illustrated lectures on Japan at the university during the week beginning November 14.

DR I SNAPPER, professor of pharmacology and general pathology, University of Amsterdam, addressed the University of Wisconsin Medical School on November 1 on "Non-excretory Functions of the Kidney"

THE Westbrook lectures for 1928 of the Wagner Free Institute of Science, Philadelphia, will be given in March by Dr Dayton C Miller, of the Case School of Applied Science, on "The Science of Musical Sounds" Four lectures will be given

DR. FRANK C MANN, director of the division of experimental surgery and pathology at the Mayo Clinic and Mayo Foundation, Rochester, Minn, will deliver the second Harvey Society lecture at the New York Academy of Medicine on Friday evening, December 9 His subject will be "The Relation of the Liver to Metabolism"

PROFESSOR JAMES KENDALL, of the department of chemistry, Washington Square College, New York University, addressed the Philadelphia section of the American Chemical Society on October 20, on "The Abuse of Water." The same lecture was delivered before the department of chemistry of Mt. Holyoke College, on October 28.

DR. THORNE M CARPENTER, chief chemist and vice-director of the Nutrition Laboratory of the Carnegie Institution of Washington, delivered a lecture at the University of Missouri on October 31, under the joint auspices of the Society of Sigma Xi and the American Chemical Society on the subject "The Carnegie Nutrition Laboratory and its Recent Studies in Metabolism"

H E HOWE, editor of *Industrial and Engineering Chemistry*, during the month of October spoke before the Southern Appalachian Power Conference in Chattanooga, Tenn., the Institute of American Meat Packers in Chicago, Ill; the Kiwanis Club of York, Pa, the Chemists' Club of Chicago, and the Milwaukee section of the American Chemical Society.

DR. W F G. SWANN, formerly professor of physics at Yale University and now director of the Bartol Research Foundation of the Franklin Institute, delivered the founders' day address at Swarthmore College on October 29.

THE Thomas Hawksley lecture of the British Institution of Mechanical Engineers, on "Application of X-rays to the Study of the Crystalline Structure of Materials," was delivered by Sir William Bragg, on November 4.

AN effort is being made by the Southwark Borough Council to commemorate Michael Faraday, who, the son of a blacksmith, was born in Southwark, England The purpose of the council is to establish a Faraday memorial collection in the central reference library The collection will consist of the biographies, portraits and published works of Faraday, and the best and latest books on the sciences and their applications, particularly electricity, with which Faraday's name is identified. It is purposed to establish a Faraday memorial fund, the annual income from which will be expended each year under the direction of a special committee, exclusively for the purpose in view

DR. WILLIAM R ORNDORFF, professor of organic chemistry at Cornell University, died on November 1, aged sixty-five years.

DR. JOHN C WARREN, professor emeritus of surgery at the Harvard Medical School, died on November 4, in his eighty-sixth year.

H. M. TAYLOR, F.R S., senior fellow and formerly mathematical lecturer of Trinity College, Cambridge, distinguished by his contributions to mathematical science, died on October 16, at eighty-five years of age.

DR. J W MOLLISON, formerly inspector-general of agriculture in India and who was the first head of the Imperial Agricultural Research Institute at Pusa, died on October 4, aged seventy years

PROFESSOR MAX VON GRÜBER, president of the Bavarian Academy of Sciences and formerly head of the department of hygiene at the University of Munich, died on September 16.

PROFESSOR HANS LEO, head of the department of pharmacology at the University of Bonn, has died, aged seventy-four years.

THE United States Civil Service Commission states that the position of professor of chemistry at the Hy-

gienic Laboratory, Public Health Service, Treasury Department, is vacant, and that, in view of the importance of the position in the field of medical, chemical and public health research, and to insure the appointment of a thoroughly qualified man for the work, the qualifications of candidates will be passed upon by a special board of examiners, composed of Dr G. W. McCoy, director of the Hygienic Laboratory, Dr Charles L. Parsons, chemical engineer, Mills Building, Washington, D C, Dr. Julius Stieglitz, head of the department of chemistry, University of Chicago, Dr Charles H Herty, Chemical Foundation, New York City, Dr Reid Hunt, Harvard Medical School, and A S Ernest, examiner of the United States Civil Service Commission, who will act as chairman of the committee. The duties of this position will consist of planning, conducting and supervising researches in the field of chemistry as it relates to the public health The incumbent will have full charge, as chief, of the Division of Chemistry and as such will be responsible for the administration, personnel and scientific work of that division The entrance salary of this position is $6,000 a year

THE Maryland section of the American Chemical Society will act as host to the Washington, Philadelphia, Virginia, Delaware and South Jersey sections at an intersectional meeting to be held at the University of Maryland on November 26 At that time the university's newly-erected chemistry building will be dedicated. The new laboratory is a four-story structure, erected at a cost of $250,000 Additional funds for the purchase of furniture and equipment have been donated by friends of the institution as follows. *Organic*, Dr. H A B Dunning, of Hynson, Westcott and Dunning, *Analytical*, Dr. Samuel W Wiley, of Wiley and Company, Inc.; *General Chemistry*, Dr and Mrs M. L. Turner, *Physical*, Dr. Alfred R. L. Dohme, of Sharpe and Dohme, *Colloid*, Mr C G Campbell, of the Kewaunee Manufacturing Company, *Industrial*, The Chemical Alumni of the University of Maryland. The dedicatory exercises, to which the public is invited, will be held at 10.00 A. M. Dr. Edgar F Smith, of the University of Pennsylvania, will be the principal speaker. A special luncheon has been arranged The afternoon session will be devoted to the intersectional program. A series of papers have been arranged under each of the following sections Physical and inorganic, organic and biological, industrial and agricultural and the chemical education. Dr. C H. Herty will deliver an address at an informal dinner which will be held in the evening It is essential that the committee know, not later than November 18, how many plan to be present. It is desired that those attending the meeting notify Dr. N. E. Gordon, University of Maryland, College Park, Md.

ACCORDING to *Museum News* the Mid-West Museums Conference is to hold its annual meeting at St Paul and Minneapolis on November 18 and 19 One of the features of the sessions will be the joining in of the newly formed Michigan-Indiana Museums Association This group was organized at a meeting held at the Chamberlain Memorial Museum, Three Oaks, Michigan Announcement of intentions to affiliate themselves with the Mid-West Conference was made by the organizers and the newly elected officers. George R. Fox, director of the Chamberlain Museum, was elected president of the new association. Edward M Brigham, curator of the Museum of Natural History of the Battle Creek Public Schools, was named secretary

WOMEN planning to attend the meetings of the American Association for the Advancement of Science will be interested in knowing that lodging can be obtained at the dormitory of the Peabody College for $2 00 per day The Peabody and Vanderbilt Universities will be used for the meetings and there are eating places near at hand Application should be made to W N Porter, convention secretary, Chamber of Commerce, Nashville, Tennessee

THE fiftieth anniversary of the American Society of Mechanical Engineers will be celebrated during the week beginning April 7, 1930 This date marks the anniversary of the organization meeting of the society which was held at Stevens Institute of Technology. While plans for the proposed celebration have not been completed, the tentative arrangement provides concurrently for an international engineering congress of outstanding nature which will not only mark the achievements of the engineering profession for the past fifty years, but will point the way for future growth and development It is expected that this fiftieth anniversary meeting will be held in Washington, D C, thus giving it a national and international character.

AT the invitation of the American Hospital Association, representatives of eleven countries met on September 19, at the League of Red Cross Societies in Paris, to discuss an international hospital convention. The meeting was composed of representatives from the International Council of Nurses and the League of Red Cross Societies, also representatives from Belgium, Czecho-Slovakia, Denmark, France, Great Britain, Hispana-America, Hungary, Italy, Mexico, Netherlands, Sweden and the United States. At this meeting it was decided that the first International Hospital Congress should meet in the United States in June, 1929, and that the invitations extended by various European cities be taken into consideration for the second congress.

The Henry Herbert Wills Physics Laboratory, an imposing addition to the buildings of the University of Bristol, was formally declared open on October 21, by Sir Ernest Rutherford, president of the Royal Society. The laboratory is one of the finest and best equipped in the world. It stands on the Royal Fort Estate, overlooking the city. The late Mr H H. Wills was the donor, his gift amounting to £200,000 The opening ceremony took place in the main lecture theater of the laboratory, and the chancellor of the university, Lord Haldane, who presided, was supported by officers of the university and academic staff and by a group of distinguished physicists who visited Bristol for the occasion. Subsequently the chancellor admitted to the degree of doctor of science *honoris causa* Professor Max Born (Gottingen), Sir William Bragg (Royal Institution, London), Professor A S Eddington (Cambridge), Professor Alfred Fowler (Imperial College of Science and Technology, London), Professor P Langevin (Paris) and Sir Ernest Rutherford (Cambridge)

A five years' program of scientific studies in the physical chemistry of steel making to be carried out by the Carnegie Institute of Technology, the U S Bureau of Mines and an advisory board of Pittsburgh steel executives and metallurgists has been launched Twenty-six steel companies located east of the Mississippi River will cooperate in the work Pledges of support in undertaking the research program were given by 65 representatives of the 26 cooperating steel companies at a dinner given for them and members of the advisory board by President Thomas S Baker at the Carnegie Institute of Technology on October 19 The dinner meeting was preceded by inspection in the afternoon of the metallurgical laboratories of the Bureau of Mines and the laboratories of the department of metallurgy and the bureau of metallurgical research at the Carnegie Institute of Technology Speakers at the meeting included Dr Thomas S. Baker, president of the Carnegie Institute of Technology, Dr. John Johnston, director of the department of research and technology, United States Steel Corporation, Scott Turner, director, U S Bureau of Mines, and Dr C H Herty, Jr, head of the ferrous metallurgical section of the U. S Bureau of Mines, who gave a progress report on the cooperative research.

The Captain Marshall Field Brazilian Expedition, which left Chicago in June, 1926, ended with the return to the Field Museum of Natural History on October 27 of Colin C. Sanborn, the last of its members to remain in the field. The zoological section of the expedition originally included in its personnel, besides Mr Sanborn, George K Cherrie as leader, Mrs Marshall Field, Curzon Taylor and Karl P Schmidt. These other members returned at various times after completing the particular branches of the work they were interested in They obtained for the museum 4,333 specimens of mammals, birds, reptiles, amphibians, fishes, insects and other creatures The original expedition also had a botanical division in charge of Dr B E Dahlgren, acting curator of botany, and a geological division headed by Henry W. Nichols, associate curator of geology, which obtained valuable collections for those departments of the museum

UNIVERSITY AND EDUCATIONAL NOTES

An anonymous gift of $150,000 has been made to Princeton University for the establishment of a chair of geography to be known as the Knox Taylor professorship

The Harvard Medical School has been made the beneficiary of a sum amounting to $150,000 by the will of the late William A Purrington The bequest is made "for research work in the field of medicine, with special reference to the application of medical knowledge to the department of dentistry"

Dr Ernest Shaw Reynolds has been appointed professor of plant physiology in the Henry Shaw School of Botany of Washington University and physiologist to the Missouri Botanical Garden Dr J M Greenman, curator of the herbarium, Missouri Botanical Garden, and professor of botany in Washington University, has been placed in charge of graduate work in the Henry Shaw School of Botany. Dr Roland V L. La Garde has been appointed research assistant on the staff of the Missouri Botanical Garden

Ralph L Shriner has resigned his position as associate in research at the New York Agricultural Experiment Station, Geneva, N Y., to accept an assistant professorship in organic chemistry at the University of Illinois

Dr. Charles L Swisher, professor of physics at North Dakota College, and Dr. John E. Pomeroy, formerly of Bethany College, have been appointed assistant professors in the department of physics at Yale University

Dr. W. F. Wenner and Dr. L A Brown have been appointed to assistant professorships in zoology at the State University of Iowa.

Dr. Melville J Herskovits, lecturer in anthropology at Columbia University, has joined the faculty of Northwestern University.

Dr. J Duesberg, professor of anatomy at the faculty of medicine of Liége, who, during the war, served

in the Johns Hopkins Hospital at Baltimore, has been appointed rector of the University of Liége for the period 1927–1930

PROFESSOR H VILLAT, of the University of Strasbourg, has been appointed to the newly established chair of the mechanics of fluids at the Sorbonne

DISCUSSION AND CORRESPONDENCE

THE TILDEN METEOR, AN ILLINOIS DAYLIGHT FALL

ON the afternoon of July 13, 1927, at about 1 00 P M central standard time, a stony meteor, hereafter referred to as the Tilden meteor, fell near Tilden, Illinois, about forty-five miles southeast of St Louis, Missouri The meteor fell in an area roughly two by seven miles, and four stones have been recovered, three of which weigh, respectively, one hundred and ten, forty-six, and nine pounds. The fourth is a small piece weighing a fraction of a pound

The meteor came from the southeast, its path being inclined at an angle of perhaps fifty degrees to the horizontal, and with a velocity equal to, or slightly in excess of, the parabolic Its brilliancy was such that at a distance of more than a hundred miles it appeared as "a piece falling off the sun" At a height of fifteen or twenty miles it burst, showing green and then purple, and after a second bursting was invisible to persons at a distance. A cloud of smoke was visible near the point of fall, but the falling pieces quickly had their velocity reduced so that they were no longer luminous by daylight, and only one piece was actually seen while falling It was seen as "a dark streak, like smoke, for an instant"

The sky was partly cloudy in the vicinity of the fall, so few there saw anything, although nearly every one was looking, after the house-shaking blasts of the detonations. Following the detonations a roar like a tornado, or an earthquake, rolled to the southeast and died away in the distance The meteor travelled with a velocity greater than that of sound, so the roar from the more distant portions of the path was heard after the detonations of the bursting in the nearer portion. This helped in evaluating the stories of the few who saw anything, for every one heard the sound rolling toward the southeast and assumed the meteor was travelling in that direction. The stones were actually seen to fall, and the smoke to roll, in the opposite direction.

The falling stones made a hum like an airplane flying high. The two larger stones could both be heard over considerable territory and at one place five men were out in a group straining their eyes to see an aviator who "flew over and passed out of hearing in the northwest, then came back flying much lower and landed a little to the north of the group."

The three larger pieces were heard to strike, the largest a few seconds after the blasts, the forty-six-pound piece "perhaps three minutes after," and for the nine-pound piece we have two careful estimates, "three to five minutes" and "five to eight minutes." The fact that for even the largest stone the thud of striking the earth was heard after the detonations of the bursting meteor shows that the average velocity of the fall from the point of bursting to the earth must have been less than the velocity of sound Since the velocity of this meteor was twenty-five to thirty miles per second in the upper atmosphere, and sound travels at the comparatively leisurely rate of a mile in some five seconds, we have a striking illustration of the tremendous resistance of the lower atmosphere to bodies travelling at high velocities

The soil of the territory is rather a stiff clay, and it was very hard because of no rain for weeks. The largest piece struck on the edge of a field of cow-peas, and went down three feet ten inches The forty-six-pound piece went down fifteen inches in a clover pasture The nine-pound piece went down five inches in grass in a back yard, and the small piece was found lying on a lawn The fall was nearly vertical at the last, the largest stone departing about six inches from the vertical in penetrating three feet ten inches. The impact in no case noticeably scattered the soil, the holes were simply driven into the ground The nine-pound stone was easily lifted out of the hole For the forty-six-pound piece a little digging with a pocket knife was necessary, and the removal of the one hundred and ten-pound stone required two hours' hard work for two men with spade, pick and crowbar It was wedged "as if it were set in concrete"

The meteorites are composed of a light gray stone, and show small silvery globular aggregates, presumably of nickel-iron The surfaces show typical pittings and a typical black crust, being blackened and pitted in fairly uniform fashion. From a preliminary study of the literature available, this fall appears to be the first recorded from the state of Illinois, and the one hundred and ten-pound stone ranks among the largest seen to fall and preserved reasonably intact. Plaster casts will be made of the larger stones of this fall

It should be said that the information in this note was obtained by personal interview, the writer visiting people, not only in the vicinity of the fall, but more than a hundred miles from that point.

CHARLES CLAYTON WYLIE
UNIVERSITY OF IOWA

ETIOLOGY OF EUROPEAN FOUL-BROOD OF BEES

SINCE Cheshire and Cheyne investigated the cause of foul-brood of bees in England and attributed the

etiology of the disease to *B. alvei*, which is almost invariably found in large numbers in infected larvae, much work has been done to corroborate their results In no case, however, has an isolated culture of *B alvei* been known to produce the disease On the other hand, G F. White and others have refuted the claim of Cheshire and Cheyne and ascribed infection in this disease to *B pluton* Owing to their inability to cultivate and isolate the organism, however, their claim has remained hypothetical, for it could not be determined whether this organism was itself merely a secondary invader—as they said was *B alvei*—or whether the infection was mixed, or whether, indeed, these organisms played any pathological rôle in the disease

It has been the writer's fortune, however, to develop a medium admirably suitable for the growth of *B pluton* (White) An 0 15 per cent concentration of agar, together with certain nutrients, is employed as an enrichment medium, and a concentration of 1.5 per cent agar for the isolation of the organism at 37° C. By this method pure cultures of *B pluton* can be readily obtained, provided the larvae used contain a preponderance of this organism

The writer has obtained infection in a healthy colony of black bees in four days, using as inoculum cultures of the organism derived from isolated colonies. The symptoms of the diseased larvae accorded with those observed in naturally infected larvae, and the microscopical picture was typical—*B alvei* forms being also present, though only in small numbers The organism has been reisolated successfully

Morphological studies thus far suggest the identity of the two organisms While the results in this are not yet complete, cultures of *B pluton* have been observed to change to *B alvei* form, resembling biologically the *B alvei* isolated from infected larvae This further corresponds very closely with the changes observed in brood naturally infected, where the ratio of *B alvei* to *B pluton* generally increases as the putrefaction of the larvae progresses, so that *B pluton* is almost eliminated. The more conclusive substantiation of this is anticipated, and its accomplishment should lead to the demonstration of important relations between the pathogenicity of microorganisms and their life stages

DENIS R. A WHARTON

OTTAWA, CANADA

NOTE ON A SECOND OCCURRENCE OF THE MOSASAURIAN REPTILE, GLOBIDENS

IN 1912 (Proc U S Nat Mus., vol. 41, p 479) the new genus and species, *Globidens alabamaensis* Gilmore, was established on a rather meager specimen from the Upper Cretaceous of Alabama. The unusual globular form of the teeth as contrasted with the pointed, sharp-cutting teeth of other Mosasaurians made this an outstanding genus on which Dollo has subsequently founded a distinct family, the Globidensidae.

Recently I have received for examination the crowns of two teeth collected from the Selma Chalk, in the vicinity of Saltillo, Lee County, Mississippi, by a student of Prof J M Sullivan, of Millsaps College, Jackson, Mississippi.

The crowns of these teeth show no evidence of wear and this fact, in conjunction with their relatively small size, would indicate that they were probably germ teeth which had not yet come into use The globular form of their crowns, with wrinkled enameled surfaces, however, are in perfect accord with the teeth of the type specimen.

The fragmentary character of the specimen contributes nothing new to our knowledge of this little known Mosasaurian, but it is of interest as recording a new occurrence, and especially in definitely locating its geological occurrence as being in the Selma Chalk

CHARLES W GILMORE

U S NATIONAL MUSEUM

MORE AND BETTER ETHICS FOR SCIENTIFIC MEN

THAT the code of ethics[1] adopted at the Santa Fé meeting of the Southwestern Division, American Association for the Advancement of Science, has been found by Dr Kempton[2] a subject for genial mirth, seems to call for comment from some other quarter than that immediately involved, the members of the Southwestern Division having, one might say, cramped their style in controversy by the adoption of Rule 4 Thus, as so often, a new law works hardship first upon the law-abiding.

Dr. Kempton, as a resident of the Atlantic coastal plain, can hardly be expected to understand the distressing conditions prevailing in scientific and educational circles in outlying provinces west of the Appalachian Highland It is a source of deep gratification to us in the West to learn that the conditions deprecated in the resolutions mentioned are nonexistent in the East, which we have so long been taught to look to as the home of culture, truth and grace. The writer is glad to be corrected in his evidently erroneous assumption that Rule 10, for example, might, in the awkward gambols of its play-

[1] "A Code of Ethics for Scientific Men," SCIENCE, Vol LXVI, No 1700, pp. 103–104, July 29, 1927.

[2] Kempton, J. H, "Scientors appear in the Southwest." *Ibid.*, Vol LXVI, No. 1711, pp. 354–355, Oct. 14, 1927.

ful youth, tread upon as many corns east as west of the Mississippi River Be that as it may, if the wild scientists of the woolly west desire to pass resolutions to protect themselves from outside aggression and internecine strife, we should expect such ambition for self-improvement to be lauded rather than condemned by the cultured exponents of an older civilization east of the Alleghany Mountains.

In defense of the southwest code, we note first that it is specifically stated to be "tentative" We take this to mean that any of the rules may be altered or stricken out to which there is sufficient objection at home or abroad Furthermore, it appears that the code is intended by members of the Southwestern Division to apply only to themselves, as we understand it, they have no intention—and probably no hope—of applying their reforms to scientists at large. There is, therefore, no occasion for immediate alarm, unless it be on the part of individual eastern scientists who intend, for climatic or other reasons, to migrate to the Southwest

Now it would be invidious to intimate that Dr Kempton would personally violate, or condone the violation of, any of the rules in question We interpret his attitude rather as a kind of Menckenese objection to the appearance of anything savoring of a Rotarian philosophy among scientific men For this point of view there is much to be said But as between the two extremes of super-sanctity and sub-Menckenism we plead for a carefully weighted mean

We should like to believe that scientific men as a class are above the need of a code of ethics But the enthusiasm with which we commonly refer to an admired colleague as a gentleman *and* a scholar seems to involve a tacit admission that the virtues connoted by these two terms may exist separately as well as in combination.

It may be urged that, if a scholar be not already a gentleman, he can not be made one by any array of rules or resolutions. Alas, too true! But it would appear advantageous at any rate to have a definite code, by which one might decide for himself whether or not he is a gentleman, instead of depending on his colleagues to tell him, which sometimes causes lasting embarrassment on both sides. Then, too, even if it be antecedently improbable that anything can be done about the ethics of the present generation, there is the coming generation to consider—the nascent Ph D's and innocents yet unborn. Is it not our duty to provide that they may learn by precept what it is not wholly certain we can teach them by example?

If, in view of these weighty arguments, it should seem desirable to follow the lead of the physicians, southwestern scientists and other groups of professional men in semi-public service, and to adopt a code of ethics to apply to scientists at large, we propose that, somewhere near the bottom of the list of needed reforms, the following be included:

Rule 160z. Scientific men shall be restrained from flailing each other through the medium of the press. The following penalties shall be provided

(a) For gentle sarcasm the offender shall be given n black marks, in a large book to be kept by the Secretary of the National Research Council

(b) For open satire he shall be given black marks to the number of $2n+1$

(c) For burlesquing or lampooning colleagues, he shall receive a number of black marks to be represented by the expression

$$-\log\frac{1}{(n+1)^{n}}$$

(d) For comparing colleagues, by direct statement or implication, with realtors, insurance brokers, chirotonsors or morticians, he shall be turned over to the ministrations of practitioners of said professions, successively, in the order named

In conclusion, I hasten to specify, on behalf of both Dr Kempton and myself, that such rule shall not be retroactive in its application *Ex hoc malo proveniat aliquod bonum*

Robert C. Miller

University of Washington,
Seattle

SCIENTIFIC BOOKS

Les Physiciens Hollandais et la Methode Experimental en France au XVIIIème Siecle Par Pierre Brunet, Paris, 1926

An Introduction to the Study of Experimental Medicine. By Claude Bernard, translated by Henry Copley Greene and Laurence J. Henderson. New York, Macmillan Co 1927

There never was a time when man did not use the experimental method of investigating his environment. There never has been a time when man did not form hypotheses on observations made thus and in other ways. An editor of Bacon's *Novum Organum* more than a hundred years ago remarked that Sir Isaac Newton had a very extraordinary method of making discoveries When he was engaged in his famed inquiries about light he seemed first to have imagined in his mind how things were and afterwards contrived his experiments Newton boasted he made no hypotheses, but no mind will work without hypotheses. There can be no doubt Newton made hypotheses both before and after he contrived his experiments on light or gravitation either It is remarkable there was once a majority of scientific men who, less than a hundred years ago, talked about 'the experimental

method in such a manner the inference was justified that obtaining knowledge by the experimental method is the only way of obtaining knowledge Claude Bernard was born in the year 1813, in that year Dr. Shaw wrote the above in the appendix he added to his translation of the *Novum Organum*. Magendie was Bernard's teacher and the inheritor of what the Dutch had been so instrumental in introducing to the French a hundred years before Paul Bert, who succeeded to the chair of his master, says this book of Bernard's, published first in 1865, struck cultivated minds with admiration and astonishment, and it may be added threw many of the admirers off their base and into a foolish exaggeration which is not apt to be repeated now, sixty years later that it appears in the admirable form given to it in this translation

It is seldom it is thought worth while to republish any work of medicine or general science after sixty years, but this work is in the same class with the *Novum Organum* I fancy it is the lingering tradition of the mental obsession to which Bert refers we may look for the interest the publishers expect It is opportune that we have Brunet's book to enlighten us as to how the experimental methods entered France so long before Bernard made it unreasonably dominant, an exaggeration against which he repeatedly protests Such exaggerations are always to be expected to attend the advent of every manifest step forward in the progress of thought and the achievements of men, but we must realize that Bernard has no claim and made none to having first introduced modern experimental methods in France

When the House of Hanover crossed the channel to govern England there was a large following from the Netherlands, though perhaps not so large as Holland had sent over with her Prince of Orange and long before that the English Puritans had fled to the Low Countries from the British Isles, so there had been large and frequent interchange between the two nations for many generations before Even the war between the Dutch and the English on the water had done something It was not broadsides alone of shot they had fired into one another It was ideas too they had exchanged after Lord Bacon's death. The new learning and the models by which Bacon and Newton shaped it made a deep impression on the Dutch, but they had no thought of not making hypotheses Much which Newton called mathematics, others called reasoning, they insisted Although the mathematician, left to his own processes, "never deviates into sense," he must have a beginning that is to him rational if not sensible, while the result to the layman is neither, but sensible is a word that long since has begun to be slippery in usage. Physics formed the basis of Newton's mathematics and reckoning from it was more exactly done than by hypotheses, but in mathematics hypotheses also have to be used. The Dutch followers of Newton saw more clearly than some of his later English, but s'Gravesande declared that in order to arrive at the admirable wisdom of Newton every physicist should see to it that his reasoning was not founded on simple hypotheses alone At Utrecht they instituted a large laboratory supplied with instruments of every kind then procurable for the study of physical phenomena, yet s'Gravesande laid down the maxim that the student should try to imagine in his own mind how the phenomena he was about to investigate could arise Despite his warning that some method more reliable should form the basis of his projected work, six rules for the use of hypotheses were given by the Dutch savant and Brunet says he was apparently not far from thinking that "truths" themselves of physics are only high probabilities. Consequently the results of the experimental method are naught but hypotheses, however close to the truth they may come We can not deny the experimental method is more often the origin of theories than of facts. Thus early in the Baconian and Newtonian creed did heresy arise when transported to the continent by their disciples Nevertheless it was they who transmitted to France long before Claude Bernard a rational experimental method. It was not Bernard who was responsible for an irrational experimental method which caused much of the falling away of students in science in France in the latter part of the last century rather than the Franco-Prussian war

Not only did primitive man experiment with the experimental method, but when science dawned in our civilization it was not entirely neglected by the old Nature Philosophers, though we have scant record of any. Hippocrates and Celsus, however, are recorded as having resorted to it in medicine and Galen was one of the greatest experimenters who ever lived. Neither Bacon nor Bernard were the earliest pioneers, nor the Italian School. Men believed Bernard had but followed in the path of Bacon, but he did far more than that. He was the most important of his critics. He was no bigot who believed that pure induction from observed facts can often lead directly to the truth. In this many, who have insistently quoted him for two generations of scientific men, have totally misapprehended him and English readers are put in the way by the present volume of avoiding this error. As to his inspiration by Bacon, nothing could be more erroneous. The chief criticism which Bernard aims against the methods of modern science is not against the neglect of experimental science which had

long flourished in France before him but specifically against the mistaken ideas of Bacon, evidently motivated by the abuse of the precepts of the inductive methods of research In the introductory chapter of his work he insists that "the experimental method is nothing but reasoning by whose help we methodically submit our ideas to experience—the experience of facts. . The experimenter must be at once theorist and practitioner. . . It is impossible to devise an experiment without a preconceived idea"

The chances were forty years ago that a student on entering a laboratory for the first time was adjured by the director to approach his problems with an open mind almost so insistently that the student had reason to believe he was to approach them with an empty mind He must have no preconceived ideas as to the solution of them This was mere drivel It put a premium on infancy and idiocy. Claude Bernard was supposed to be the protagonist of such doctrine, for the history of medicine, especially of science, was not wide spread among laboratory workers in those days Bernard insists "facts are necessary materials, but their working up by experimental reasoning, i e, by theory, is what establishes and really builds up science" Bernard seems, by the frequency with which he sounds this note, to be protesting against certain pernicious tendencies in French methods of the pursuit of science. It was the revival of a new science in the Netherlands, which was the origin of its juvenescence in France. There were more solid cultivators of it than Voltaire, but when he returned from England he made the ideas of science he had imbibed there popular Probably his friend, Mme du Chatelet, understood them better, but he was the greatest propagandist of them all, so that through him a very much more extended stratum of the people became acquainted with the ideas, which several years before had arrived by the way of Holland and were thus given a wider circulation than otherwise would have been the case from the introduction Nollet was able to give them among learned men

Descartes and his philosophy had had a great effect on the teachings in the universities of Holland, but most of the physicists there appreciated the inefficiency of his doctrine Boerhaave in his doctor's thesis in 1693 had already published matter in which he dwelt on the importance of the experimental method in medical research. In less than ten years he had acquired a great reputation at the University of Leyden, which extended throughout Europe. Leeuwenhoek had already communicated his observations with the microscope to the Royal Society of London, but it was in 1715 that s'Gravesande was appointed secretary to the embassy sent to congratulate George I on his accession to the crown of England. By means of one of the students he had had in the *Low Countries* he gained the acquaintance and the esteem of Newton and became a member of the Royal Society When he returned to Holland Boerhaave had pronounced a discourse *De Comparando in Physicis,* which acted as a sort of primer of science for future work in Holland After that the names we know of those who became indoctrinated with the ideas of the experimental method in science there are numerous Thither Voltaire repaired to consult Boerhaave about not his health alone, but about the new things in science In France already Nollet's influence had become marked among men of science When the instruments then in use in the neighboring country became known in France they were constructed with more precision there, but Brunet does not forget the indebtedness not alone of France but of England and Holland also to the Italians, Galileo, Torricelli, Redi, Borelli Milton drew on Italian culture for his great works in literature. Harvey, Willis, owed a deep debt to them. Later, however, the current of advance in methodology in science flowed through England, and with the impulse of Bacon's crude revolt from scholasticism behind them the new departure found its way to France very largely through Holland

It was Boerhaave and s'Gravesande and Muschenbroek and doubtess many others who introduced and developed an admirable experimental method in the early part of the eighteenth century in Holland. They yield in no way to their great protagonists in England in that acuity of intellect, which manifests itself by talent and common sense rather than by genius. They escaped many of the errors of Bacon and Newton They got their cue from them, but when the mantle fell on their shoulders science made vast strides in the Netherlands In its earliest years in France there had already been some instruction given and some exposition of the experimental method by Polinière, but already the fame of Boerhaave was spreading there as well as elsewhere in the continent and in England and students were going to him from the latter country, whence at the beginning of the century he had drawn his first inspiration Vaillant, who had been fired by the lectures of Boerhaave, left a posthumous book in the care of the latter, a confidence which Brunet thinks exceptional in a Frenchman for a Dutchman at that time, but its title has a significant interest for us Boerhaave, five years after Vaillant's death in 1722, published it at Leyden and Amsterdam in 1727 as the *Botanicon Parisiense*. In France Castel had been provoked to attack Boerhaave for too much worship of Newton as the greatest of physicists and especially because he wished to banish every sort of hypothesis, which exclusion Castel was quite right in declaring often stops access to the truth, claiming that

even Boyle in England had given utterance to much of the same criticisms. But the work of Vaillant found its way into France and Noguez in 1725 translated a work of Niewentyt and in 1731 Boerhaave was elected to membership in the Academy of Sciences at Paris. Nollet, in 1738, was made the incumbent of a public chair of experimental physics in Paris founded by Cardinal Fleury. It was in Italy, in Florence, however, that there existed the oldest Academy of Experimental Physics in Europe

JONATHAN WRIGHT

PLEASANTVILLE, N Y

SPECIAL ARTICLES

LONG-LIVED CELLS OF THE REDWOOD

THE principal features of long-lived cells in the massive stems of cacti have recently been described by the senior author[1] Medullary cells of the tree cactus (*Carnegiea*) were seen to remain alive for periods well over a century and the results of the examination of elements of all ages indicate active enlargement during the second half of the century.

Another cactus, the melon cactus or bisnaga (*Ferocactus*), which has an ovoid-cylindrical trunk was found to include similar medullary cells of great age which, however, ceased to grow after the first decade. The development of the outer cortex as a layer several inches in thickness is of such character as to demonstrate that the cortical cells have a similar period of enlargement and survival.

In all of these cells the carbohydrate components, pentosans and hexoses progressively decrease with age The fatty substances, or lipins and nitrogenous substances, change least.

Transformation of sugars to wall-material with consequent thickening is apparent in *Carnegiea* and in the medulla of *Ferocactus*; crystals of salts accumulate in all cases. It was notable, however, that in the cortex of *Ferocactus* the disappearance of the carbohydrates extends even to the walls, which are thinner at a hundred yards than at ten, suggesting the liquefaction and removal of pentosans. It seems probable that the only consumption or use of the lipins from these cells is of that which may be in the walls and cytoplasm, and that these substances in the nuclei are but little affected

That ray cells may attain an age of many years in the whitish sap wood of tree trunks is implied in the writings of many authors. We can not find any definite statement of living cells in heart wood, although Strasburger's account of starch in trunks of the red beech 125 layers from the surface suggests that these cells might be alive.[2] The negative assertion that "only the outer layer of the wood composed of the more recently-formed annual rings thus contain living cells and constitutes the splint-wood" made in the 14th German edition of Strasburger's text-book of botany and found on p 158 of the 5th English revision as translated by Lang in 1921 may be taken as a correct presentation of present knowledge of this matter

Certain features of behavior of the trunks of the California Redwood uncovered by our study of the hydrostatics of this tree led us to examine the parenchymatous cells of the trunks There are two different types of living cells in newly-formed secondary xylem of *Sequoia sempervirens*· wood-parenchyma cells that stand in vertical files scattered among the tracheids, and ray-parenchyma cells As in most other woody stems, the wood-parenchyma and ray-parenchyma cells of the alburnum or whitish sapwood are living and densely packed with starch

The change from alburnum to duramen (heartwood), macroscopically recognizable in *Sequoia* by a brownish-red coloration of the duramen, is accompanied by a disappearance of starch and protoplasts from all wood-parenchyma cells and the formation of an orange-colored resin that completely or partially fills the lumen of the wood-parenchyma cells. For this reason wood-parenchyma cells are often called resin cells The transition from alburnum to duramen is also accompanied by a disappearance of starch from the ray-parenchyma cells but this disappearance of the starch is not always followed by death and disintegration of the protoplasts. These living ray cells of the duramen have a thin layer of cytoplasm next the wall, a conspicuous nucleus, and a large central vacuole. The ray cells may remain unchanged for a long time and we have observed ray-parenchyma 70 layers deep in the heartwood with clearly defined protoplasts and apparently normal nuclei As the sapwood in such trees included 21–23 layers these cells were about a century old. Cells of older annual increments in these stems also appeared to be living but this could not be determined with certainty since the granular nature of the cell contents obscured the nuclei. Some trees have ray-parenchyma cells that show a granular cytoplasm and small droplets of resin shortly after the transition from duramen to

[1] D T. MacDougal "Growth and Permeability of Century old Cells," *Amer. Naturalist* 60, 393–415, 1926, and Frances L. Long, "Characters of Cells attaining Great Age," *Amer Naturalist*, September–October, 61, 385–406, 1927

[2] Strasburger, E. "Ueber den Bau und Verrichtungen d Leitungbahnen in den Pflanzen" Pp. 274–275 1891.

alburnum; still others have the same behavior in ray-parenchyma and wood-parenchyma and both elements in the outermost ring of heartwood contain resin only.

The reasons for this marked variation in the behavior of ray-parenchyma cells are as yet unknown The age of the tree does not appear to be a factor, for we have found both conditions in young and in old trees Neither is there any sharp correlation with the environment Trees high on the dry flanks of hills or deep in the canyons of this vicinity may have living ray cells deep in the duramen

That these cells should survive during the pronounced changes in chemical constitution of the wood, altered composition of the sap and lessened oxygen supply is a remarkable occurrence The nuclei undergo but little change and a superficial examination suggests consumption of the carbohydrates. The well-known abrupt diminution of starch in the rays occurs in the redwood at the stage of transition from sap to heartwood The ratio of length of life of these cells to that of their growing period is the highest known Full size is reached almost at once—within a few days—life may continue for a century or four thousand times the duration of the growing period In *Carnegiea* medullary cells continue to enlarge for a century, in *Ferocactus* life continues for a period ten or twelve times the growing period which extends over a decade.

It is notable that the known long-lived cells of plants are all of the simple parenchyma type as in contrast with the highly specialized long-lived cells of the brain and heart of vertebrates.

The medullary cells of *Carnegiea* which grow for a century, as might be expected, retain their embryonic character Those of the medulla and cortex of *Ferocactus* do not. The long-lived cells of the redwood lose their capacity for division at an early stage and play no direct part in the formation of calluses, or other regenerative action so marked in the redwood. In what way the existence of these numerous strips of living cells in the heartwood, which may reach an age of more than a century, affect the pressures and movements of liquids and gases in this tree is yet to be determined. The facts presented seem to constitute the first announcement of living cells in heartwood, as well as an extension of knowledge of the occurrence and behavior of long-lived cells.

D. T. MacDougal
Gilbert M. Smith

Laboratory for Plant Physiology,
Carnegie Institution of Washington
and
Department of Botany,
Stanford University

GLUCOSE AS AN ANTAGONIST

For some years the senior author has been engaged in the study of the habits and means of control of the onion root maggot (*Hylemyia antiqua* Meig). Experiments have included extensive investigation of the chemotropic responses of the flies to various substances. Cane molasses has always proved a very satisfactory attractant and NaCN has long been known and used as an effective insect poison In consequence, a mixture composed of ¼ ounce of NaCN, 1 pint of molasses, and 1 gallon of water, was included among the various poisoned baits it was desired to test

In the summer of 1925, Mr K Stewart, working on the same problem, found that the NaCN-molasses bait gave very satisfactory results, ranking first of all the materials tried in the average daily catch of Diptera These records were obtained by the use of wire fly-traps of the Minnesota type placed in the onion fields on the College farm, with the various poison baits in glass dishes under the traps.

The NaCN-molasses combination, as one of the most promising of the mixtures under trial, was selected by the senior author for further experimentation in 1926 It continued to give very satisfactory results so far as the catch of flies was concerned, but some doubt was experienced as to the extent to which this mixture was acting as a killing agent. Accordingly, cage experiments were started indoors in order to settle this point It was found that while the NaCN combination was even *more* attractive to the flies than molasses and water alone, its toxicity was practically nil Upon uncorking a bottle of the mixture which had been well shaken and then allowed to stand for several days, a distinct odor of ammonia was noticed, while that of HCN could no longer be detected. Moistened litmus paper gave the alkaline color reaction when held near the mouth of the bottle. Apparently, the –CN group had been decomposed, giving rise to ammonia, the evolution of which gas no doubt explains the enhanced attractiveness to the flies of the poisoned bait over that of a simple molasses-water solution.

The most probable explanation of the production of ammonia in the above mixture appears to be that of interaction between the NaCN and the glucose of the molasses to yield glucose cyanhydrin, which subsequently hydrolyzes, as follows.

$$NaCN + H_2O \rightleftarrows NaOH + HCN$$

$$CH_2OH(CHOH)_4\,CHO + HCN \rightleftarrows CH_2OH(CHOH)_4\,CH(OH)CN$$

$$CH_2OH(CHOH)_4\,CH(OH)CN + H_2O \rightleftarrows CH_2OH(CHOH)_5 \cdot COOH + NH_3$$

Glucose solutions to which NaCN was added were found to give essentially the same results as did the molasses bait, but to a more pronounced degree Further confirmation of the hypothesis respecting the origin of the ammonia is afforded by the results obtained with a mixture of cane-sugar solution (of the same specific gravity as that of the molasses used) and NaCN in the proportions of ¼ ounce of the latter to 1⅛ gallons of the former When this mixture was used in cage experiments it was found that the HCN given off usually was sufficient to kill most of the flies without their having the opportunity to start feeding. Sucrose, having no free carbonyl group, would of course not undergo the cyanhydrin reaction

In connection with the above, it is interesting to recall that Rasputin, the Russian monk who dominated the court of the late Czar, is reputed to have used glucose as a protection against sundry attempts upon his life by means of poison Such results as have been described would suggest that this precautionary measure was well taken, in the case of NaCN at least. In addition, the findings of Heinekamp[1] respecting the resistance of various types of fowl to strychnine, furnish evidence that here also glucose, or its polymer glycogen, may have a rôle as antagonist in the case of the alkaloids as well as in that of the less complex poisons

ALEX. D BAKER
W A DELONG

DEPARTMENT OF ENTOMOLOGY,
MACDONALD COLLEGE,
MCGILL UNIVERSITY

GEOCHRONOLOGY AS BASED ON SOLAR RADIATION

IN this journal of 1920 was mentioned a part of my plan for an investigation of certain laminated clays in North America

During a previous visit in this country in 1891, I had, at several places, observed laminated clays similar to analogous late glacial melting sediments in Sweden, which I had found, after long-continued investigations, to represent the annual deposition from the melting water along the border of the retreating ice-edge

By help of a certain graphic method for the comparison of the sharply marked annual layers or *varves*, I had succeeded in identifying such varves from one point to another and ultimately worked out a systematic plan for the elaboration of a continuous time scale This was in the main carried out in 1905–06 on the basis of field measurements made, for a considerable part, by a great number of able young assistants During the following years this standard line was completed at many places. I thus succeeded, step by step, in tracing the recession of the ice border and the immediately following transgression of the clay-varves over one region after the other, until the whole line from southernmost Sweden to its central parts had been controlled

As was to be expected, the lowest and oldest clay-varves were found to be deposited in the southernmost part of the land, while the great ice-sheet still covered the rest By following the clay transgression step by step, the whole staircase-like series was gradually built up, forming a continuous and exact time scale for the last ice-recession across Sweden up to a certain year when a great ice-dammed lake in central north Sweden was drained off, and a thick annual varve was deposited, which has been chosen as representing the very end of the late Glacial Epoch proper

For many years I tried in vain to find out any means of determining the length of this Postglacial Epoch, until one of my most successful assistants, R Lidén, discovered, in the northern parts of Sweden, measurable annual varves which represent that epoch.

Of varves from this epoch, I measured in one section at the Indal River somewhat over 3,000, but it was along the Angerman River that Lidén quite independently succeeded in finding and working out practically the whole of the Postglacial varve succession by a careful and painstaking combination of a long series of sections, showing the total length of the Postglacial Epoch to be about 8,700 years.

What made his work especially important is that there seems to be no other place in the world, not even in Sweden, where there is any possibility of finding such a continuous varves series for the whole of the Postglacial Epoch.

By noting the position of the bottom varves, the ice-recession in Sweden has been determined in detail at certainly more than 1,500 different localities, while sections down to the very bottom varve elsewhere—excepting in Finland—have but rarely determined the front margin of the lowest varve.

Thus, along the Connecticut Valley, according to Antevs' exceedingly interesting and comprehensive varve measurements, the bottom of the clay layers was so seldom exposed that the bottom varve, which marks the stage of the ice-recession, could only be determined at one point along the whole of the southern four fifths of the measured line of ice-recession. Even the remaining fifth part of the line, which is north of a gap in the section not represented by clay deposits, the bottom varve was located at only five points.

[1] Heinekamp, W. J R, "The Resistance of Fowls to Strychnine" *Jour Lab. and Clin. Med* 11, 209–214 (1925)

Though in this region it is not yet possible to know exactly the rate of ice-recession, the numerous measurements of long varve series have afforded valuable material for detailed teleconnections with the time scale in Sweden and a thorough and very satisfactory verification with respect to the thickness variation of the varves of some otherwise uncontrolled parts of the Swedish time scale

Furthermore, though it has not been possible, even to such an admirable varve tracer as Dr. Antevs, to find a continuous varve series through the late glacial part of the time scale in Canada, this is, happily enough, of less importance since the extended teleconnections with the already minutely controlled Swedish time scale afford an equally good but much more convenient and time-saving method

Thus it is neither necessary nor advisable to use uncertain estimates or perhaps quite erroneous assumptions for filling out gaps between actually measured varve series, if the whole sum really is to be trustworthy

Furthermore, considering that the initiative, the organization and method of the investigation are totally of Swedish origin, and, as it seems, it is only in Sweden that the time scale can be continued all the way up to our own age, it may be fully justified to name this chronologic standard line the *Swedish Time scale*, even where it is identified and completed by parallel measurements in other countries

The main purpose of an exact international chronology must be the reference of different kinds of events everywhere to one and the same time standard

The necessary condition for the introduction of such a time scale was, of course, the possibility of identification, even at great distances, of synchronous varve variations This condition seems now to be realized

Thus, almost all of the varve series measured in 1920 by the little Swedish expedition to North America have been with certainty identified with corresponding series of the time scale in Sweden, as illustrated by some examples representing a few thousands of years, published in the *Geografiska Annaler*, Stockholm, 1926.[1] Quite lately the author has also succeeded in identifying a series of nearly 600 varves, carefully measured in Argentina by one of my former pupils, Dr. Carl Caldenius.[2] Also a description of E Norin's varve measurements in northwestern Himalaya, carried out and identified by him in 1925 and 1926, will soon appear in the same journal.

Considering that the distances between Sweden and the other regions are no less than 6,000–14,000 km., the similarity of more than 80 per cent. of the whole varve number between the identified varve series is very astonishing but quite convincing with respect to the long and uniform succession of characteristic varve variations, which, naturally enough, have not been possible to connect in more than one single way It is especially noteworthy that this similarity continues century after century, thus, as it seems, putting it beyond every doubt that only a real identity is able to explain such a considerable sum of similarities.

Here it must also be emphasized that it was first after many totally vain attempts that the striking correspondence was discovered, and then was at once found to be continuous over practically the whole of the varve series.

A close study already made of the published diagrams will soon show that a mere accident here must be totally shut out This remarkable coincidence of such rapid variations at such considerable distances, caused by simultaneous ice-melting, seems not to be explicable in any other way than by variations in the amount of heat from the sun Thus in reality, we have to do with nothing less than a gigantic, self-registering thermograph, showing the variations in the radiation from the sun

With respect to the physics of the sun, it is of interest that there exists an observed biennial variation as well as the annual one, this latter being indicated by the connection of the varve variation of the two hemispheres, so that the north and south summers, with their closely corresponding varves, point to a natural *thermal year* Still it is undetermined whether that year begins with the one hemisphere or the other

It may be of interest for the elucidation of this question to include also the southern part of the Cordilleran observations which are analogous to the renowned measurement of the solar radiation which, for two decades, have been executed on the sunny heights in the far West of the United States.

Whatever may be the astronomic cause of the annual solar variation, it seems likely that its beginning and end probably are to be found somewhere between the north and south summer, or not far from the equinoxes. When this has been fully stated, our annual means of temperature ought to be calculated for the natural thermal year, which ought to give much more characteristic results than the means of the arbitrary fiscal year.

[1] G. De Geer, "On the Solar Curve, as Dating the Ice Age, the New York Moraine and Niagara Falls through the Swedish Time Scale" Data, 9 *Geogr Ann*, Stockholm, Vol. 8 (1926), pp 253–284, Pls. 1–3 (varve diagrams and map).

[2] G. De Geer, "Late Glacial Clay Varves in Argentina, measured by Dr. Carl Caldenius, dated by Means of the Solar Curve through the Swedish Time Scale." Data, 1. *Ibidem*, Vol. 9 (1927), pp. 1–8, Pl 1 (varve diagrams).

Though it may be granted that the varve variation as to its dominating features all over the earth is a function of the sun radiation, at the same time it is still more or less influenced by local factors, such as the bottom topography at different localities together with changes in the direction of the melting rivers, the varying composition of the morainic material from which the clay is washed out, and other circumstances. By parallel measurements at different localities, many such deviations from the true solar curve will probably be eliminated, but meanwhile it is not advisable to transcribe the varve thicknesses in figures intended for smoothing calculations

Yet a really convincing graphic connection already observed makes it possible for the first time to introduce in an exact way the time factor into a great number of geophysical investigations hitherto beyond our reach. Thus, to mention a few examples, the possibility of mapping and dating synchronous land ice borders over great areas in different regions of the earth enables us to take up, with respect to the physics of large ice bodies, a rational study of ice movement, of ice extension, and of its recession as a function of melting as well as of fracturing

In the papers quoted, some hints are given concerning the use of time determinations for a closer geophysical study of other processes, of inorganic as well as of organic nature, such as the evolution of our actual climate and the erosion along our rivers as well as our lake and sea shores In these papers was especially mentioned the magnificent example of Niagara Canyon, the age of which has now been geochronologically dated by means of good varve connections Thanks to the excellent measurements by American and Canadian geologists, we have here a prime example of the amount of river erosion under certain conditions during a non-determined space of time

Here may be mentioned furthermore the new possibilities of studying, step by step, how the ice recession was followed by the formation of soil and vegetable mould and the immigration of the whole flora and fauna within the former great ice deserts, which afford unique possibilities of supplying certain branches of geology with exact geophysic studies.

GERARD DE GEER

THE NATIONAL ACADEMY OF SCIENCES

(*Continued from page 434*)

The meliolineae FRANK LINCOLN STEVENS The Meliolineae are highly specialized biologically This results in an isolation comparable in general to local geographic isolation. A species on a given host may remain limited to that host over long periods of time. During the lapse of time modification of the fungus occurs resulting in distinct varieties. Further changes lead to specific, even generic, differentiation. It thus happens that distinct but related forms are found on one host species The evolution of these occurred during the tenancy of this phylum on this host The occurrence of complexes of numerous related species on a given host family is very striking No significant deductions from geographic distribution are evident, indeed, the most striking fact is the relative evenness in which the various genera and species are distributed over the Meliola world Apparently evolutionary tendencies have operated in diverse areas in much or quite the same way The course of evolution appears to have been from the non-hyphopodiate, 8 spored forms with persistent asci and spores of variable septation to hyphopodiate, 2–4 spored forms with evanescent asci and spores of definite septation, leading to the establishment of six genera within the group It appears that these genera are of polyphyletic origin, each having arisen several, perhaps many times, from different ancestral stocks.

Some studies on the composition of vegetative and fruiting plants E J KRAUS (introduced by John M Coulter) Accumulating evidence on many types of plants shows that there is often a marked tendency for the gradual accumulation in the proportion of carbohydrates and carbohydrate-like compounds in excess of the nitrogenous constituents as the fruiting stage approaches. In some instances the differences in composition seem more specifically related to the relative solubility of the nitrogenous and carbohydrate constituents than to changes in actual proportions of these substances, the more fruitful plants containing a larger proportion of relatively insoluble substances. The general trend of the results is the same whatever the external environmental factors concerned in prolonging or shortening the vegetative period.

Progress with work on disease-resistant plants. L. R. JONES

The dynamics of plant growth to soil conditions, with special reference to oxygen and carbon dioxide. BURTON E LIVINGSTON (introduced by W. A. Noyes).

The quantum efficiency of the photochemical decomposition of anhydrous formic acid: WESLEY NORMAN HERR and W ALBERT NOYES, JR. (introduced by Julius Stieglitz) The number of quanta required to decompose one molecule of anhydrous formic acid in the liquid state has been determined. The light intensities were measured by means of a thermocouple and the transmitted light subtracted from the incident light to obtain the amount of light absorbed. The source of light used was a quartz mercury arc lamp. The amount of decomposition is determined by gently boiling the liquid until the decomposition products are removed and then by measur-

ing the pressure increase in a constant volume. As pointed out by previous workers, the hydrogen formed during the reaction does not appear as a gas but probably reduces formic acid. As the average of several determinations it is found that 2.21 quanta are required on the average to decompose one molecule of formic acid. A possible effect of dust is indicated as the above figure became 1.57 when dust was present. When only wavelengths longer than 300 m are used the number of quanta per molecule is 3.25. Similar measurements were made on formic acid vapor. To measure the decomposition products, the vapor was condensed with liquid air and the gaseous products swept into a McLeod gauge with a Toeppler pump. The process was repeated until no further pressure increase was noted. Addition of carefully purified hydrogen showed that hydrogen was used up in this case also. The number of quanta required to make one molecule decompose in this case was 1.48. Measurements with the solid were inaccurate due to difficulty in determining the amount of reflected light. It is found that there is no obvious relationship between the energy required to decompose one molecule of liquid, the energy required to decompose one molecule of vapor and the heat of vaporization. Possible effects of the light in the two cases will be discussed.

Electrochemical theory of oxidation and neutralization reactions. W. H. RODEBUSH. The electromotive series of the metals can be extended to include most of the elements and groups of inorganic and organic chemistry. The groups at one end of this series will be recognized as both strongly oxidizing and strongly acid forming. This is not a coincidence. These groups have a deficiency of negative electricity. This deficiency may be satisfied in three ways: (a) A hydrogen ion may be lost, (b) an electron may be acquired, (c) a neutral atom itself deficient in electrons may be given up. (a) is a typical neutralization reaction and (b) and (c) are characteristic oxidation reactions. Numerous examples can be cited.

Progress in the concentration of illinium. B. S. HOPKINS. Illinium was detected in portions of rare earth material that had been derived from monazite sand, the separation being accomplished by fractional crystallization mainly as double magnesium nitrates and as the bromates. The concentration obtained by these means, while adequate for identification, probably did not exceed one per cent. of illinium. Efforts are now being directed to increase the amount of illinium in various ways. (1) Fractionation as double magnesium nitrate and bromate is being applied to a large quantity of monazite residues. (2) Other methods of fractional crystallization are being used, such as the perchlorates, ferricyanides and dimethyl phosphates. (3) Determination of the relative basicity of illinium as by the fractional precipitation with NH_4OH and $NaNO_2$. (4) Separation of illinium from its neighbors by means of the varying ionic velocities. (5) Other minerals, especially those rich in neodymium and samarium, are being examined for illinium. The results so far obtained indicate that the best method of concentration is by means of the fractionation as double magnesium nitrate and as bromate, although the fractionation as dimethyl phosphate looks promising. The ionic migration method has possibilities which are attractive, although the results so far obtained are not conclusive. It seems probable that the basicity of illinium will place it between neodymium and samarium, although work on this phase of the problem is especially tedious. One quantity of American samarskite was tested for illinium with negative results, but the present indications are that fergusonite contains a larger proportion of illinium than monazite. Other ores such as cerite, allanite, gadolinite and tscheffkinite are now under investigation as possible sources of illinium.

The critical stage of the earth's megadiastrophism. T. C. CHAMBERLIN.

Factors governing the low temperature carbonization of high oxygen coals. S. W. PARR (introduced by W. A. Noyes).

Hydrazoic acid, an ammono nitric acid, a nitrous acid hydrazide and an ammono hyponitrous acid. E. C. FRANKLIN.

Isolation of the alpha form of methyl alpha glucoheptoglucoside and its acetate. C. S. HUDSON.

Glacier motion as a type of rock deformation. ROLLIN T. CHAMBERLIN. In an endeavor to decide between viscous flow and crystalline yielding, measurements of the internal shearing in various glaciers were made with a self-recording clockwork apparatus. The results show that slipping takes place along definite shearing planes, at times gradually and at other times by distinct jumps. The capacity to withstand a certain amount of growing stress before yielding is indicated. Four manifestations of glacier movement are recognized: (1) Solid flow by idiomolecular exchange between ice crystals, (2) solid shearing of aggregates of granules, (3) intermittent slip along well developed thrust fault planes, and (4) sliding of the whole body of ice over the rock beneath. Here is a rock of simplest sort actually undergoing deformation before our eyes. It gives concrete illustration of many of the phases of earth deformation which have been interpreted chiefly from results remaining from the past.

Concerning the metal in meteorites. GEO. P. MERRILL (with lantern slides). The paper gives a brief résumé of opinions relative to the metallic constituent of stony meteorites, and dwells mainly upon its physical properties as compared with artificial material. It is shown to partake of the nature of artificial so-called wrought iron and undergoing decided changes on fusion under ordinary conditions. Particular attention is, however, called to the position of the metal relative to the silicate constituents and the conclusions to be drawn therefrom.

The influence of oscillating sea-level on the development of the continental shelf: FRANCIS P. SHEPARD (introduced by David White).

Lake Illinois and the problem of its duration: M. M. LEIGHTON (introduced by T. C. Chamberlin).

Evolution of the odd numbered elements: W. V. HOWARD (introduced by H. S. Washington). When the isotopes of the elements which have been determined by Aston and others are plotted on coordinate paper with the atomic numbers as abscissae and the mass numbers as ordinates they are found to have certain definite relationships to one another. These may be expressed as follows: (1) The isotopes of the even-numbered elements between carbon and polonium form two groups of series, of which one group conforms to the equation $M = 2N + 4X$ and the other to the equation $M = 2N + 4X + 2$, where M is the mass number, N the atomic number and X a whole number between 0 and 11. (2) Each series corresponding to any given value of X in one or other of the two groups is terminated by an element which has an isotope with an odd mass number, and in some cases two such isotopes. (3) The odd isotopes of the even numbered elements may lie immediately above the lowest and second lowest even numbered isotopes or above either of these, but never occupy a higher place in the list of isotopes of any element. (4) The elements whose lower isotopes terminate one or more series have higher isotopes which begin one or two others. (5) No element has more than five even isotopes (xenon excepted). (6) The above rules do not hold in their entirety for the two series in which $X = 0$. (7) No odd-numbered element has more than two isotopes. (8) No odd numbered element has an isotope with an even mass number. (9) No odd numbered element has an isotope whose mass number is the same as that of any isotope of any other element, odd or even. (10) If an odd numbered element has two isotopes, the following even numbered element can not have more than one odd isotope. (11) The isotopes of all odd-numbered elements have a mass number which is less by one than one or other or both of the two lowest isotopes of the even numbered element immediately following. These rules do not hold for nitrogen, the elements below carbon in the periodic table or the radioactive elements. By means of these rules the isotopes of those elements which have not yet been successfully attacked may be predicted with results which agree very closely with those of Russell. These relationships together with certain experimental results and the occurrence of the different elements in the earth's crust suggest that the odd numbered elements were formed from the lowest isotopes of the even numbered elements by the loss of a proton and an electron which combined to form atomic hydrogen. If it be assumed that this change has taken place, it is possible to account for the amount of water in the ocean and the great quantity of juvenile water which is being constantly added to the earth's crust. The process of magmation becomes one whereby disintegration of the odd numbered elements at a comparatively shallow depth below the earth's crust raises the temperature of the rocks and at the same time provides water, which results in the lowering of the melting-point of those rocks so that a magma may be formed. The theory of the radioactive control of mountain building becomes one of mountain building caused by non-radioactive disintegration of the elements. All the heat involved in mountain building, the formation and rise of magmas, and the heat radiated from earth's crust may be supplied from this one cause alone.

Evolution of the odd-numbered elements: W. V. HOWARD (introduced by H. S. Washington).

The ordovician section of northwestern Illinois: E. O. ULRICH.

Some factors in rock metamorphism: DAVID WHITE.

The Shinarump conglomerate and its associated vertebrate fauna: E. C. CASE (introduced by F. G. Novy).

Influence of oscillating sea-level on the development of the continental shelf: F. P. SHEPARD. Evidences of changing relations of land and sea are found on almost every coast. Little has been done to determine whether such changes are dominantly a result of crustal warping or of the shifting of the sea level. The problem has been discussed chiefly in connection with coral reefs. Since these reefs occur mostly in very unstable regions, the results can not be said to be very satisfactory. There is a terrace-like submarine platform around the various continents, which is covered by rarely exceeding water, 600 feet. It is terminated by a fairly steep slope which leads down to the deep ocean basins. This is known as the continental shelf. A study of this feature should throw light on the question of sea level changes. Previously only small parts of the shelf have been considered with any care. The present study took in all parts of the shelf. The results of the study lend much support to the idea of shifting sea-levels. Hills, valleys, delta flats, terraces, are found in abundance along all parts of the continental shelf. In connection with coral reefs studies it has been proposed previously that the sea was lowered by glaciation about 200 or 300 feet. Such lowering does not appear to be adequate to explain the features mentioned above, which are indicative of sub aerial or of littoral erosion and deposition. It seems probable that during much of the Tertiary period the sea-level was from 400 to 800 feet lower than at present. In testing the validity of this hypothesis all varieties of coasts were considered, such as arid, humid, mountainous, low and so forth. The characteristics of the shelf adjacent to each type of coast were compared with predictions based on the various hypotheses for the origin of the shelf. In each case the actual conditions appeared to fit the newly suggested hypothesis much better than the others. If such considerable changes of sea-level have occurred, many coastal features formerly ascribed to diastrophism can be explained without it.

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OBJECTIVE AND HUMAN PHYSICS

The twofold view of nature is as old as theoretical physics. The picture in which nature presents itself to the observer is complicated, but Democritus, the great Greek thinker, had already recognized that this complication is only apparent, and the result of the peculiarities and limitations of the human senses. It was the idea of Democritus that the picture of nature to which true thinking leads must be of much greater simplicity than that which man receives through his senses. The necessary condition for the simplification of physics had therefore to consist in the liberation of physics from all human, from all subjective, points of view

Democritus also recognized that the objects of the simplest physical events must be much smaller than any object amenable to sense-perception. The exploration of hidden atomic events thus became the essential aim of objective physics

As soon as the true size of atoms was evaluated by exact methods, the primarily speculative hypothesis became exact scientific knowledge. To-day we can determine the mass of atoms with comparatively greater accuracy than the mass of the earth. Not only through one but through the most varied and independent methods the characteristic constants of atoms can be determined in the most accurate manner; and all these methods, independently of each other, have led to the same values. If it can be regarded as an argument for the existence of our external world that the sensations of sight, hearing and touch all lead us to infer the existence of the same objects, then theoretical physics has certain proof of the real existence of atoms in the fact that their characteristic constants, as obtained by fundamentally different methods, have nevertheless always the same values.

Modern physics, based on the exploration of atomic processes, has revealed to us a picture of nature of great simplicity. It has clearly shown that it is not nature that is complicated, but only the path leading to a knowledge of it, and that this path consists in the gradual transformation of the subjective world-picture into an objective one.

But if the objective picture be the true one, then it should also be possible inversely to construct the subjective human picture from the objective one. We can then raise the question of how, under given powers and limitations of the human senses, nature may reappear in a picture produced by these senses. We

can ask how, from such a subjective picture of nature, a physical science can originate and how, out of the objective qualities of nature, the real development of physics, created by man, is to be understood. I shall discuss briefly these questions.

First, let us ask how nature, of which man receives a certain picture through his senses, may be constituted in reality, how it would appear to a spirit, say to an imaginary demon whose perceptive faculty admitted of no restrictions whatever and who could compare sizes and compare times, but for whom words like "large" and "small," "quick" and "slow" would have no meaning at all.

To such a spirit, matter would reveal itself in countless primordial particles of only twofold sorts Could he isolate some of them and examine their mutual influence, he would find out that primordial particles of the same sort repel each other, whereas those of opposite kinds attract each other If he were to construct the fundamental mechanical conceptions, such as force and mass, in the same way as is done by man, he would recognize that the particles of one sort have a mass about 1,850 times greater than the particles of the other sort He might distinguish the particles of greater mass as positive protons from the other sort which he might call negative electrons

The spirit would perceive aggregates in which positive and negative primordial particles are comparatively close together, but where the positive particles always have a majority. He might call these aggregates nuclei Furthermore the spirit would find how negative electrons revolve round these nuclei like planets round a central sun. Such a system formed out of a nucleus and revolving negative electrons might be called an atom by the spirit

He would find that the orbits in an atom can not be arbitrary ones, but only such that a certain magnitude characterizing the motion in the orbit is exactly a whole number multiple of a definite elementary magnitude Something like the so-called "harmony of the spheres" would reveal itself in the regularities of the orbits described round the nucleus.

The spirit would also recognize that, as a rule, the number of negative primordial particles contained in an atom is either perfectly or with a small difference equal to the number of positive primordial particles. In the first case (the case of perfect equality) it might speak of a neutral, in the second case (the case of imperfect equality) of a charged atom. Among the various species of atoms perceived by the spirit, one type would strike him by its particular simplicity, namely, those atoms in which only a *single* negative primordial particle runs around a single positive primordial particle which represents the nucleus.

The spirit would also find that out of atoms of a single or of several kinds complexes are formed by mutual attraction which often contain two or more atoms In this case he might call the said complexes molecules. In some cases he would find single atoms which might be called monatomic molecules

The spirit would recognize as the most frequent state of matter a state in which the molecules are wildly shooting in all directions, causing perpetual collisions between them Such a state of matter might be designated by him as gaseous. On the other hand, he might speak of a *solid* state if the atoms are arranged in a definite manner so that the internal motion of matter consists in oscillations Between the two extremes of the gaseous and the solid state intermediate stages will be perceptible

Moreover the spirit would find that only a vanishingly small fraction of space is really filled with matter, but that, on the other hand, matter is concentrated in formations which contain, at least in order of magnitude, the *same* number of primordial particles, a number between 10^{55} and 10^{60} Such formations, rising and disappearing, might be called stars by the spirit. He would find that in the stars the internal motion and also the force of collisions are so tremendously violent that any durable formation of molecules and probably also of complete atoms is prevented

Around the stars the spirit would recognise formations like our earth which consist of a thousandth or a millionth as many primordial particles and in which the motion gradually being retarded is relatively much slower than in the central stars. When, for instance, the spirit considers the processes on earth, he would find that the internal motion is relatively so slow that both the most solidly constructed nuclei and the atoms and, as a rule, even the molecules wholly withstand collisions

If the spirit considered any position in space for a given instant, he could determine the magnitude and the direction of the force which would be exerted upon a primordial particle should it be there This force, measured by any scale, might be called the electric field-strength existing at the given position at the given instant. The spirit would find out moreover that the strength of the electric field can vary periodically in its magnitude and direction, as well as in space, namely, from position to position, and in time from instant to instant. If there exists such a double space-time-periodicity, the spirit might speak of electric waves.

He would find space filled with such waves of very different lengths and of very different frequencies. If a wave has a frequency two, four, eight or sixteen

times as great as another, the spirit might say that its oscillations lie one, two, three or four octaves higher.

The spirit would also recognize that there exists a close correlation between the electric waves and alterations in the structure of matter. Besides the normal states of atoms and molecules there are possible, as the spirit would find out, also abnormal states in which the grouping of the electrons round the nucleus differs from the usual. Such alterations of configuration either require a supply of energy, or energy becomes available through the alteration. The spirit would perceive that the energy liberated can be transformed into energy of an emitted electric wave. Conversely he would find that the energy supplied can spring from an absorbed wave. But he would recognize that in both cases the frequency of the wave can be considered as an immediate measure for the resulting transformation. This rule might be called by the spirit the frequency-condition.

As the simplest atom, we have previously considered one in which a single negative primordial particle revolves round a single positive primordial particle. If this simplest atom passes from its normal state to an abnormal one, which differs the least from the normal, this transition would appear to the spirit as the simplest among all possible alterations of configuration occurring in the atoms. The frequency corresponding to this simplest transition might be considered by the spirit as a standard frequency. Frequencies which extend to about twelve octaves lower or to about fourteen octaves higher than this standard-frequency are produced by alterations in other atoms or in molecules.

Apart from the attraction and repulsion between the primordial particles, the spirit would find a universal attraction of matter. This attraction which he would recognize to be proportional to the product of masses might be designated by him as gravitation. He would notice that gravitation is vanishingly small when compared with those electrical forces already mentioned. If he considered, for instance, two positive primordial particles and if he calculated the ratio between their mutual force of repulsion and their gravitational force, he would find it to be about 10^{36}.

Gravitation, therefore, can act its part only between enormous accumulations of primordial particles, for gravitational effects of the particles are always added, whereas the electrical effects originating from the primordial particles compensate each other by reason of the *neutrality* of matter.

Only in exceptional cases can electrical forces rising from large bodies become so strong as to be able to move other bodies, which are also composed of countless primordial particles, provided the neutrality be removed in a sufficiently large part of the molecules or atoms. Similar results are produced by certain forces which are exerted upon each other by two revolving electrons on account of their revolutions, and which the spirit might designate as magnetic forces. These forces generally compensate each other, but in some substances the compensation can be so imperfect that the magnetic effect may be revealed by comparatively strong forces between bodies containing countless atoms.

Thus far, I have tried to sketch the objective picture of nature as it would appear to a spirit. From the same nature man receives a subjective picture by means of his senses. To all things he first applies a human standard. His body consists of an enormous number of atoms, about 10^{28}, each of which represents in itself a planetary system. Thus it is not astonishing that man considers as exceedingly small such objects as present themselves to the spirit as complexes of many millions of atoms. The shortest movements executed by the human body appear tremendously long from the standpoint of atomic processes. In the time which man needs even to lift an eyelid, each of the electrons in each of his atoms performs millions and millions of revolutions. In a similar way the electric waves filling space perform millions and millions of oscillations during the lifting of an eyelid.

On the other hand, the duration of man's life appears vanishingly short as compared with some physical processes recognized by our spirit, for whom such words as "long" and "short" do not exist. Much that may appear to the spirit in impetuous evolution, like the stars, may afford to man the deceptive impression of duration and immutability.

As the most important human sense-organ, the spirit would recognize one which reacts upon electric waves belonging to a very narrow region. This region comprises but a single octave and reaches from about three to about two octaves below the standard-frequency I mentioned before. The spirit, however, would find that this human sense-organ which he might call the eye is not sensitive to the electric waves which lie beyond those narrow limits.

The spirit would find in man also a sense-organ through which man can recognize whether the internal motion of matter with which he is in contact is more intensive or less intensive than the internal motion of the matter forming the human body, which motion is nearly constant in its intensity. This human sense might be called the sense of temperature.

By means of his eyes man obviously can perceive or, as we might say, he can see such objects which either emit electric waves or which absorb waves of definite frequencies from the totality of electric waves

filling the space, provided (and this is very essential) that the frequencies emitted or absorbed belong to the range of that octave for which human eyes are sensitive. If for such objects the visual angle is not too small, man can perceive them and recognize their size and shape by their boundaries

On the earth where man lives, matter possesses an internal motion which is relatively so slow that he is surrounded by durable nuclei, atoms and, as a rule, also molecules. Those molecules and atoms which absorb any frequencies belonging to the octave perceptible to the human eye give rise to colored impressions This happens mostly in the case of solid bodies, but not in the case of the gaseous matter which covers the solid earth as atmosphere and which remains invisible to man owing to the absence of respective absorptions

Man will differentiate countless substances according to the molecular properties which reveal themselves to him These substances correspond to the numerous forms in which about twenty frequent varieties of atoms are found combined Occasionally man perceives the result of a process which would present itself to the spirit as a formation of new molecules caused by the decomposition of other molecules of two or more sorts Such rearrangements must appear to man, who distinguishes substances according to their molecular properties, as transformations of substances

On the other hand, the forces acting between the atoms of one and the same substance must also undergo a loosening with increasing intensity of the internal motion. This will become manifest to man by finding that the state of matter depends upon temperature He will find that bodies which usually have a solid form lose it with increasing temperature and even evaporate under a still higher temperature

Apart from the bodies found on earth, the stars distributed in the space of the universe will be the object of human perception Their distances, of course, can not be estimated by an untrained observer. He will put them all into the same indefinite distance. In this way the aspect of a sphere is produced which appears to be covered with stars and might be called by man the firmament

The velocities of the stars are exceedingly great as compared with terrestrial velocities Nevertheless, owing to the enormous distances involved, perceptible changes in the apparent configuration of the firmament are not, as a rule, possible during the lifetime of a man. The only exceptions are made by such objects in the firmament as belong, like the earth, to the sun and which might be called by man planets The changes of their positions in the firmament caused by their proximity must soon awaken the interest of the observer; and in a still higher degree this must be the case with the moon, the companion of the earth.

Thus from the very outset several fields of phenomena become apparent to the careful observer which might be made the objects of scientific research. He first finds plenty of work in two fields in which he can develop an activity, which might be called "cataloguing"—on the one hand by the description of the firmament, on the other hand by the description of the substances amenable to sense-perception and of their properties and changes Two branches of science which might be called astronomy and chemistry must thus first result from the consideration of the subjective world-picture

Furthermore, man observes changes of position or motions both on the earth and in the firmament, without at first recognizing a connection between terrestrial and celestial motions In the case of terrestrial motions he again distinguishes two kinds on the one hand, so to speak, the forced motions which he produces himself either immediately by means of his arms or indirectly by means of mechanical contrivances invented by him, on the other hand, there are the natural, or ordinary motions which are caused by the gravitational field of the earth and which are chiefly revealed to man in the phenomenon of falling

Now and then man may also discover motions which are caused by electrical or magnetic forces These will occur when matter appreciably differs from neutrality or from complete compensation of the electron orbits. These anomalies are, of course, due to special molecular or atomic properties. Therefore, man will ascribe the faculty of putting other bodies into motion, only to substances that appear unique to him.

Another object of the study of nature may be the process of vision itself The untrained observer of nature can not have any idea what the physical process may be which occurs in the space between the eye and the object perceived As his conception of nature is thoroughly subjective, he will even assume this process to originate in and from his eye

But, in any case, it becomes evident that electric waves in the objective sense of this word change the direction of their propagation if they strike upon bodies or pass through them. For under certain circumstances man sees objects in other than their real positions. He discovers a reflection—by closer observation occasionally also a refraction—of the rays which he assumes cause vision. In any case, many problems result from the spatial relations of the three positions: where the eye is, where the object is in reality, and where the object seems to be.

Finally, the sense of temperature must also open up to man a peculiar field of phenomena in which he can make various observations. On the one hand he

perceives continuous fluctuations of temperature in nature. On the other hand, he learns artificially to vary the temperature The changes which are produced in the structure of bodies by changes of temperature may also become subjects of research; and above all man must be interested from the beginning in the processes thus taking place in the atmosphere

Thus, in the first period, human physics, based on the subjective world-picture, chiefly consists in the recording of the phenomena which nature spontaneously offers to the observer During this earliest period of physics—I should almost like to say during its prehistoric period—man first recorded the stars perceived by him According to the accidental apparent proximity in the firmament, which proximity in itself has nothing to do with the real arrangement in space, he classifies the stars in groups or so-called constellations He pursues the apparent course of sun and moon and the apparent orbits of the planets in the firmament He recognizes those properties of the various substances found on earth which are amenable to his sense-perception He pursues the course of the rays which he assumes cause vision. He observes, although at first in a rather superficial manner, the natural and the forced motions, and for practical reasons he occupies himself with the question of how, if he makes use of mechanical contrivances, he can bring about the desired effect with the least expenditure of force And this question must lead him up to the investigation of the equilibrium of simple machines.

Among these various fields of phenomena, there are two in which numerous physical theorems may be gained from relatively few empirical conceptions, by means of deductive mathematical methods. On the one hand, the comprehension of a single simple case of equilibrium is sufficient for the solution of rather difficult problems of equilibrium by means of geometrical knowledge. On the other hand, the geometrical method also renders possible a study of the complicated problems of reflection of rays, provided a single, simple physical law be discovered in this branch of science

Thus the earliest phase, the cataloguing phase, of physics is followed by a period in which physics begins its development into an exact science. During this period it still shows a purely mathematical character The great achievements of the Greeks in statics and catoptrics are characteristic of this early period Chemistry and the study of heat, on the other hand, remain in their rudimentary phase In astronomy the study of stars advances, and a geometrical theory, becoming more and more complicated, tries, with increasing accuracy, to describe the apparent orbits of planets.

Thus exact physics in its beginning is but a branch of applied mathematics But by and by, through the work of physicists, the small amount of existing empirical material will be enlarged The result of this work must greatly accelerate progress in physics, for new physical knowledge brings about new methods of research

While in the first period physics remained restricted to passive observation of spontaneously occurring events, now the processes to be investigated are artificially produced by systematic experiments. Thus man becomes not only able to vary at will the essential attendant circumstances and the degree of the processes, but events which must remain hidden to the passively observing individual become amenable to his natural or to his refined instrumental perception. The inductive method is finally combined with the deductive one The investigator derives from the established facts by mathematical deduction new conceptions which he then verifies by new experiments.

In the period of physics which follows the purely mathematical one, mechanics and optics are chiefly developed Exact dynamics originates from the investigation of the simplest motions caused by forces, such as from falling The exploration of this phenomenon delivers the key for the discovery of the fundamental laws of motion The exploration of the mechanical properties of air which are hidden from immediate sense-perception shows how human perceptive faculty has already grown beyond the limits drawn for human sense-organs

In optics the study of refraction causes the invention of means which artificially raise the faculty of the human eye to a high degree. Instruments thus invented not only produce previously unsuspected discoveries in various fields of natural science, but also allow a much closer observation of the optical phenomena themselves Thus gradually the knowledge arises that light constitutes a wave-like process

The science of heat developed much more slowly than that of mechanics and optics Because here the establishment of magnitudes which might be exactly measured is much more difficult than in mechanics and optics where all quantitative relations are based upon lengths, angles and times

In chemistry experimental researches lead to the finding of numerous, previously unknown substantial transformations. Their closer investigation leads to the gradual discovery of the chemical elements which correspond to the varieties of atoms and which reveal themselves as the undecomposable constituents of chemical compounds.

The advancing perfection of experimental methods must finally place in the foreground those phenomena

which are the most original and important from the objective point of view, but which play the most subordinate part in the primitive subjective world-picture, namely, electric and magnetic phenomena That these phenomena may become perceptible, matter must, as I have already mentioned, deviate from its usual neutrality The physicist gradually contrives means artificially to raise these divergences. Thus he can explore phenomena which the untrained observer perceives only in a weak, occasional and exceptional way In studying bodies which are built up of countless atoms, he gradually discovers those electric and magnetic laws which are valid in the atoms themselves

The detailed investigation of phenomena in the various branches of physics must necessarily render physics more and more objective Such a liberation from subjective human points of view is first to be expected in astronomy An ingenious thinker discovered that the most complicated planetary motions appear very simple if astronomy gives up her subjective geocentric point of view In the same way, a great physicist arrived at the discovery that the motions of planets and their satellites represent the same phenomenon as the motions of falling, daily perceived by man on earth

The identity existing between the internal motion of matter and visible motions must likewise reveal itself to the physicist It becomes manifest by the fact that in the production of heat by mechanical work as well as in the converse process a constant ratio is found to exist between the quantities of heat and mechanical energy mutually converted Thus the theoretical physicist is led to recognise that the phenomena of heat consist only in invisible and hidden motions He also finds how by this assumption many perceptible properties of gases can be simply explained

That physics becomes more and more objective also becomes manifest in the investigation of electric waves (in the objective sense of this word) In the investigation of these waves man advances more and more beyond the boundaries which at first are drawn by the limitations of vision Already the untrained observer perceives not only those electric waves of a single octave which appear to his eye as light, but also electric waves of a much greater wavelength which he feels as heat-rays through his temperature sense. The identity of light and heat-rays must become manifest to advancing science On the other hand, chemical effects discovered with usual light render possible an investigation of waves shorter than those of visible light. Thus physics advances in both directions beyond the limits of the visible spectrum.

Finally the physicist becomes able to produce oscillations and waves by contrivances used by him in the experimental study of electricity, and he finds that these electric waves artificially produced show the same properties as he has long since known of the much shorter waves which he perceives as light. Thus the electric nature of light reveals itself to man. As he found the science of heat to be a branch of mechanics, he now recognizes optics to be a branch of the science of electricity

The great advances made in all branches of physics must finally open up to the investigator an insight into the world of atoms. The real existence of atoms first reveals itself to man in chemical laws which must be interpreted by the assumption that the smallest particles of chemical compounds are built up of atoms of elements Still more clearly the atomic structure and electric nature of matter manifest themselves in such chemical changes as are due to electric currents Finally a system of elements can be established, and in it such similarities between chemical elements appear which, in reality, are caused by similar arrangements of electrons in atoms

In the science of heat the hypothesis of hidden motions in itself leads to a molecular conception of matter. And the deeper understanding of the laws discovered in thermodynamics makes them appear as results of molecular statistics

In the science of electricity, the perfection of experimental methods must lead to the finding of processes in which electrons or parts of atoms constitute a perceptible radiation, and thus their closer investigation leads to the discovery of the primordial particles themselves. On the other hand, greatly refined methods of observation make it possible to perceive the consequences of rather rare events, that is occasional disintegrations of nuclei Also from these phenomena, known as phenomena of radio-activity, important conclusions can be drawn in regard to the building stones of matter

The most valuable empirical material for the investigation of atoms is, however, offered by the phenomena of the line-spectra By means of the frequency-condition previously mentioned, theoretical physicists learn to understand the language of the spectra which reveal to man the internal structure of atoms

Thus physics has arrived at its present state and at its present knowledge which I took the liberty of symbolizing in the spirit. To believe that physics has already reached perfection would, of course, be a dangerous illusion. But perhaps the physicists of to-day may have a similar conception of the state of physics as geographers may have of the state of their science.

Geographers know that to-day there are no more continents and seas to be discovered. They, however, have no doubt that in their science fundamental problems are unsolved as yet and still may occupy scholars through centuries. The state of physics, the world-picture and evolution of which I have tried to sketch, may perhaps be similar.

ARTHUR HAAS

VIENNA

LOUIS AGASSIZ FUERTES

As already noted in SCIENCE, Louis Agassiz Fuertes was suddenly killed at Unadilla, New York, August 22, when the automobile he was driving was struck by a moving train. In the many printed notices which appeared immediately after his passing, superlatives have been used freely and justifiably. "Foremost American painter of birds," says one, "Cornell's best beloved alumnus," says another, and all testify to the extraordinary personal popularity which he enjoyed.

He was indeed a unique character, the like of which is scarcely produced except in America. He was born at Ithaca on February 7, 1874. His father, Estevan Antonio Fuertes, one time dean of civil engineering at Cornell, was a man of outstanding character and ability. This father, whom Cornell students used to call "The Mogue," was of Spanish lineage, born in Porto Rico, but completing his education in New York. The mother, Mary Stone Perry Fuertes, now surviving at an advanced age, is a fine American type of English, Dutch and Huguenot ancestry. The remarkable combination of qualities developed by Louis Fuertes doubtless owed much to this parentage.

His especial professional godfathers were Abbott Thayer and Elliott Coues with whom he had close association for which he never ceased to make loyal acknowledgment. As a boy, his passion for the beautiful in nature had fairly free rein and his early drawings of birds were made practically without suggestion or guidance from others. However, neither he nor his parents thought seriously of ornithology or painting in any practical way, and his father expected him to enter the engineering or architectural profession. This idea was overcome to some extent through the influence of Liberty H. Bailey, and shortly before Louis graduated from Cornell in 1897 a fortunate coincidence led him to send a few samples of his bird paintings to Elliott Coues for criticism. The enthusiastic reply received from the great ornithologist was fulsome beyond his hopes. He was electrified with joy, and from that moment was never in doubt as to his purpose in life. Coues literally took him under his wing, hailed him as a new and better Audubon, and introduced him to the ornithological world in such a way that contracts to illustrate several books were soon in his hands.

He began at once to portray bird life in a way that appealed alike to the artist and to the ornithologist. At this time the long era of woodcuts and expensive lithographs was just passing. General interest in outdoor life and especially in birds in this country was awakening and the demand for good books of nature was growing. To say that Fuertes arrived opportunely to take advantage of the period does him injustice, for his influence was very powerful in stimulating and supporting the movement and but for him it would have been delayed or curtailed. Other artists and good ones came into the field, but it was Fuertes who set the standard, who inspired the ideal of all, and by abundant production spread broadcast the charm and beauty of birds, not merely in accuracy of line and color, but in the expression of subtle intangible qualities approaching spirituality. In effect the word went about that birds had souls and that Fuertes could see and transcribe them.

For thirty years his activity and industry were phenomenal. He illustrated book after book, sometimes with only a frontispiece or a few plates, but usually with a whole series covering all the species known from a wide area. A large percentage of the more important bird books published in America during this period contain pictures by Fuertes. One of the most important was the series of large plates in full color for Eaton's "Birds of New York" (1910), covering practically every species of eastern North America. At the time of his death he was under contract with the State of Massachusetts for a similar and even better set of plates, one volume of which had been finished and issued. He also furnished plates for various ornithological journals, for museum publications, for the National Geographic and other magazines, and for the widely distributed pamphlets and reports of the federal government. In all this, he was often under pressure, but his standard was high and the average quality of his production was never far from it. The demand for mere illustrations, however, prevented him from giving his talent the widest range. Had he lived, it was his well-determined intention to finish his contracts, to take no more which savored in the least of pot boiling, and to devote an entire year to untrammeled self-expression or, in his own words, "to paint whatever I want to paint, whether I can sell it or not"—not merely birds, but pictures, pictures with birds in them.

He had, in fact, painted such pictures before, but

his opportunities in this direction had been all too limited. A commission which he thoroughly enjoyed and in which he was signally successful was that of painting a series of twenty-five decorative panels in the private house of Mr F. F. Brewster, New Haven, Connecticut. He also did some murals in the Flamingo Hotel, of Miami, Florida, and several large paintings for the collection in the Administration Building of the New York Zoological Society. His contributions to the backgrounds of the habitat groups of birds in the American Museum of Natural History were notable. In addition, he painted a certain number of mammals and domestic animals and, while some of these which he did not know in life were lacking in sympathy and below the standard of his pictures of wild birds, there were many of high quality, indicating that he might also have succeeded in this field

In 1904, he was married to Margaret E. Sumner, of Ithaca, and their home was made "above Cayuga's waters" at the edge of the Cornell campus. There are two children, Sumner and Mary, to whom he was a most devoted father. His studio, which was detached but adjacent to his house in Ithaca, was a Mecca for prominent ornithologists from all parts of the country and a house of wonders to students of Cornell and other young people of the community. In it he kept not only his studies and sketches but an interesting assortment of curios and souvenirs picked up on his travels to various parts of the world. There was also his very choice collection of bird skins which, although it did not exceed 4,000 specimens in number, was especially selected and rounded out to meet the exacting needs of his work. This collection was largely the result of his own field work, birds that fell to his own gun, and were preserved by his own hand

In his earlier years, Fuertes sometimes said half jestingly that he was an ornithologist first and a painter afterward His genius as a painter will never be denied, but it is plain that his supremacy in his field was gained by many qualities besides mere skill as a draughtsman and colorist His knowledge of birds was exceedingly extensive and, in some respects, almost profound It was obtained mainly through direct contact with the subject Probably it is not too much to say that Fuertes had a wider acquaintance with living birds in the field than any painter that ever lived. This was because he sought them out, not primarily to paint them but to know them and to enjoy them, often at the sacrifice of time and money. It was characteristic of him to do field work under various auspices. A general favorite himself, he played no favorites and was *persona grata* in all quarters. His first long trip was with the Harriman-Alaska Expedition; later he joined a party from the U. S. Biological Survey for work in Texas and New Mexico, and for several seasons he was associated with his friend, Dr. Frank M. Chapman, in expeditions for the American Museum of Natural History to Canada, Mexico and South America. He also visited California, Florida and the West Indies. His last and longest journey was as ornithologist and artist of Field Museum's recent expedition to Abyssinia, where he personally collected and prepared no less than one thousand birds and made about one hundred paintings and sketches.

The affiliations which he made with different institutions were mutually advantageous and usually so arranged that he retained originals of sketches and paintings for himself while specimens collected were shared, but so conscientious was he that what some might have considered his own interest was often neglected He was a good shot, an ardent collector, and had such an inexpressible joy in the living bird and its surroundings that he would forget everything else including his painting His day in the field was so occupied with hunting, observing and preparing specimens that he rarely had time for painting, even though he worked far into the night. Somehow, at odd moments, he made field sketches which in the aggregate were very many, but they were largely for recording the fugitive colors of soft and unfeathered parts which are altered in the preserved specimen. For the rest, he depended upon the genius of his uncanny faculty for retaining vividly impressions of those intimate "spiritual" qualities which gave each bird he painted its own distinctive "personal" character

In the field, as elsewhere, Fuertes showed an extraordinary combination of qualities, at times almost paradoxical. Always as eager as a child, he was often as sentimental as a debutante and as sympathetic as a mother; yet he was full of a stern virility which continually manifested itself in ways that left no doubt he was a man's man. With gun in hand he was a hunter and collector, having no qualms at the shedding of blood, but with a freshly killed bird before him he would sometimes sit stroking its feathers in a detached ecstasy, purring and crooning over it in a manner that in another might have seemed ridiculous. On the trail, the sight of a new bird might cause him to abandon in a flash all practical considerations, his own safety or comfort, plans for the day, and hopes for the morrow. Yet that night in camp, it would be Fuertes who spent an hour of his precious time repairing ingeniously and most practically for someone else broken saddle gear, guns, typewriters or cameras. Pure beauty in all things fascinated him, and the exquisite combinations of

color and texture exhibited by many small birds were his constant joy, but it is significant that his favorites among all birds were the falcons, the swiftest, boldest, most dashing and, withal, the most rapacious and inexorably bloodthirsty of their kind.

In Abyssinia, Fuertes found himself in a veritable terra incognita, an ornithological world which was all new to him, and he plunged into it with an exuberance of joy. Every bird was an adventure and every moment an opportunity Patience he had at the skinning table and the drawing board, but at other times it was not always evident and in his impetuosity he was occasionally near to disaster His first day in Africa was in Djibouti on the coast of the Red Sea and, while others made necessary arrangements for progress inland or sipped cool drinks on the hotel veranda, he slipped out of the settlement, dodging local gendarmes, and in the sweltering heat collected seventeen birds which were skinned with penknives that night in the hotel. The next day on the train, after it had crossed the Abyssinian border but before customs regulations had been complied with, he was tantalized by unknown birds seen at a distance Finally, at a small station, over the heads of a gaping and jabbering crowd of Abyssinians, a beautiful blue roller alighted on the telephone wire and Fuertes could stand it no longer, but dove into his luggage for a small shot pistol and started out of the standing train intent on having the bird in his hands, come what might. It required the combined efforts of the four other members of the party with argument and at least with threatened force to convince him that the bird was not worth the almost inevitable altercation with bystanders which would follow Arrived in the capitol at Addis Ababa, Fuertes was subjected to a staggering blow. While all other equipment shipped by freight had arrived safely, his own personal outfit had suffered the mischance of being lost in transit without hope of recovery for three months. It contained his shotgun, his clothing and personal effects and, most important of all, his materials for painting and sketching. His disappointment was too keen to be wholly concealed, but when he was finally told the worst, he said at once, "Well, it simply means I'll have more time to collect birds for the Museum." His other expressed regret was that certain little knicknacks and home-made conveniences for camp life, which he had packed in sets, could not be shared with others of the party as he had intended. Nothing could be more characteristic of him than thus to see his own misfortune in the light of its relations to others.

His unselfishness in all human contacts was marked and perhaps it was but a slightly different form of this that made him so unsparing of himself in his work. He did not often look for the easiest way and would tear through brush and thickets, plunge into morasses, and fearlessly descend steep cliffs to attain his object. In the first few days in Abyssinia, an impetuous sally left him with a large thorn deeply imbedded and broken off in his leg. It could not be removed without a deep incision, so it was thought best to leave it alone. The next day the wound was inflamed and sore, but he would not listen to postponing the march He was lifted into the saddle and remained there doggedly suffering during what proved to be for everybody the longest and most gruelling day of the whole trip. Thereafter, for nearly two weeks, he mounted and dismounted in agony, but this did not prevent him from doing it many times a day in order to collect birds along the trail which might not be obtained later. Probably no picture in the many of a very eventful trip will remain longer with the others of the party than that of Fuertes laboriously easing himself from his mount to the ground and painfully hobbling away with cocked gun, alert and determined that no needed bird should escape because of any leniency to himself.

His fondness for children, so well known at home, and his tender, almost feminine sympathy for the ailing and unfortunate, were much in evidence in Africa. Beggars and cripples were a great trial to him and it was exceedingly difficult for him to pass one by. He gave to many and almost immediately would apologize to his companions, saying "I know I shouldn't do it, but I just can't help it" If he found one imposing upon him, however, his pity turned to wrath instantly. One of the caravan men, a "nigger" if one wished, developed a loathsome abscess in the groin, and Fuertes carefully washed, poulticed, and bandaged it day after day until it was completely healed. Then the man, who was a worthless wretch, flagrantly betrayed his trust as guardian of the camp, was summarily discharged, and no one was louder in approval of the action than Fuertes. His sense of justice was marked and he was outspoken in his condemnation of sham and insincerity. This extended into the field of art and science and his great personal popularity was not unbroken by a few enemies who well deserved his forthright denunciation. He had no quarter for self-seeking pseudo-naturalists and no sympathy with certain schools of new art which arrogate to themselves an insight transcending that of other mortals. There was nothing mawkish about him.

Fuertes was actively interested in a variety of subjects other than ornithology and painting. These included music, architecture, primitive art, conservation, and all movements concerned with young people. Although his conversation usually sparkled with origi-

naility and his correspondence gave much evidence of literary power, he wrote very little for publication. His most important written work appeared first in *Bird Lore* and, later, in pamphlet form under the title "Impressions of Tropical Bird Voices." It was a charming and valuable contribution to a little known subject. He was much interested in bird songs but had no fanciful ideas about them and especially condemned attempts to relate them with human music except by mere notation. His powers of mimicry were most unusual and he was greatly in demand at gatherings of all kinds, not only for his imitations of birds and other animals, but for various "stunts" for which his sense of humor and his natural histrionic talent qualified him to a remarkable degree. These things contributed to his popularity and when combined with the pure gold of his character and the achievements of his profession served to mark him as a very outstanding man

In 1925, he was made a lecturer in ornithology at Cornell and, although he took this responsibility seriously, it has been said that he accomplished more by example than by precept His influence was felt among the citizenry of Ithaca in many other ways, as a Rotarian, as a master of Boy Scouts, as a friend and guide for all young people, with the result that he is mourned not only by the university but by the entire community.

During the few weeks since his death, there have been those who have not hesitated to pronounce him the greatest painter of birds that ever lived There is much to justify such a large place for him, and time is not likely to modify it greatly. Certain it is that he marks an era for American ornithologists and that in him skill with the palette and pencil was combined with qualities of mind and character to produce a very rare result.

WILFRED H. OSGOOD

FIELD MUSEUM OF NATURAL HISTORY,
CHICAGO

SCIENTIFIC EVENTS

GIFTS TO COLUMBIA UNIVERSITY

AT the October meeting of the board of trustees of Columbia University gifts were announced totaling $210,000, including the following:

Mrs. Walter B James, $25,000 to be added to the Walter Belknap James research fellowship fund established by bequest from Dr James Laura Spelman Rockefeller Memorial, $20,000 for research in education. Borden Co, $18,000 to establish the Borden research fund in food chemistry. Mrs. Lucius Wilmerding, $14,-429.98 to be added to the special tuberculosis fund in the Medical School. J. William Clark, $10,000 for the School of Dental and Oral Surgery building fund; Walker Gordon Laboratories Co., $5,000 for research in food chemistry and nutrition; National Lead Co., Eagle Picher Lead Co., St. Joseph Lead Co., United Metals Selling Co, American Smelting and Refining Co., and U. S Smelting and Refining Co., $4,842 75 for research work in the department of physiology; Motion Picture Producers and Distributors of America, $4,500 for research in applied psychology; William J. Gies fellowship fund committee, $3,518 to be added to the fellowship fund, Fritzsche Brothers, $3,000 to provide the stipend for the Fritzsche fellowship in the department of chemistry, Hartley Corporation, $2,600 for the Marcellus Hartley laboratory; Copper and Brass Research Association, $2,500 for research in the department of physiology, William Fellowes Morgan, '80, '84S, $2,500 for the Medical School, Mines '17, $2,500 for an Engineering School student loan fund, P & S, '12, $2,472.77 for the benefit of the Medical School, Robert H. Montgomery, S. W. Adler, $1,500 for purposes to be specified by the dean of the Medical School, anonymous, $1,500 for work in public health; E I. du Pont de Nemours & Co., $750 for a fellowship in industrial chemistry; J. Russell Smith, $500 for a special fund for economic geology, Lehn & Fink, $400 for a research fellowship in organic chemistry; Miss Mary Wheelwright, $350 for research in anthropology, Mrs. Elsie Clews Parsons, $350 for research in anthropology, Gano Dunn, '91 Mines, $350 for the Gano Dunn scholarship in applied science; $300 for research in the field of Indian music; Harvard University, $250 to be added to the William J. Gies Fellowship Fund; Bunker Hill and Sullivan Milling and Concentrating Company, $157.25 for research in the department of physiology; D. H. Burrell & Co., $100 for research in the department of anthropology.

RESEARCH IN MINING AND METALLURGY AT THE CARNEGIE INSTITUTE OF TECHNOLOGY

FIFTEEN different research studies in mining and metallurgy are being carried on this year at the Carnegie Institute of Technology in cooperation with the United States Bureau of Mines and two advisory boards of mining engineers, metallurgists, steel operators and chemists. Thirteen of the problems are being investigated by college graduates appointed as research fellows, one by a research engineer, and another by an analyst.

This year's work, it is announced, is a continuation of the program that has been in effect for several years. Each research fellow is making his studies under the direction of a "senior investigator" representing the Bureau of Mines and a member of the faculty of the Carnegie Institute of Technology. Four of the fellowships are financed this year by the institute. Other organizations contributing to the expenses and the fellowship funds are the American

Gas Association, New York Edison Company, Philadelphia Storage Battery Company, and 26 companies representing the metallurgical industries. The latter group is financing six of the investigations.

Assignments of problems to the research fellows have been made as follows:

Equilibrium between manganese, iron and sulphur, by Hershall V. Beasley, University of Tennessee.

Synthesis, testing and application of warning agents for manufactured gas, by Harry A. Brown, Lehigh University.

Formation and identification of inclusions, by John M. Byrns, Case School of Applied Science.

Coal ash fusibility as related to clinker formation, by Clarence L. Corban, Rose Polytechnic Institute

Methods of determining inclusions, by John F. Eckel, University of Kansas.

Distribution of iron oxide between slag and metal, by Hyman Freeman, Georgia School of Technology

Base exchange in relation to decay and peat formation, by Raymond C Johnson, Monmouth College.

Safety, costs and efficiency of distribution of electric power in coal mining, by Donald C. Jones, research engineer.

Physical chemistry of steel making, by Frank Morris, analyst

Relation between composition and oxidizability of coal, by Harold M. Morris, Cornell College.

Viscosity of open-hearth slag, by Frank G. Norris, Purdue University.

Composition of oils and heavy tar from distillation of coal at low temperature, by Robert N. Pollock, University of Washington.

Determination of relative ignitibility of low temperature coke compared with coal, by Donald L. Reed, University of Washington.

Study of cause and control of abnormality in case carburized steel, by Alfred W. Sikes, University of Illinois.

Physical chemistry of steel making (field studies), by R. W. Stewart, Massachusetts Institute of Technology.

FOSSILS OF BAFFIN LAND

MR. SHARAT K. ROY, assistant curator of invertebrate paleontology of the Field Museum and geologist of the Rawson-MacMillan Arctic Expedition, has recently submitted to the director of the museum a report regarding the fossils collected by the expedition during the past season. The area covered included the Labrador Coast and the southern end of Baffin Land The only fossils found in Labrador were a few drift fossils that had evidently been carried down by ice from the Hudson Strait region and Baffin Land. With the exception of one solitary area north of the Strait of Belle Isle, no sedimentary deposit was found on the entire coast of Labrador. The single area referred to has been fully worked by the Canadian Geological Survey. The only important collecting ground observed was in Frobisher Bay, Baffin Land. This bay, situated on the southeast side of Baffin Land, extends in a general northwesterly direction for about one hundred and fifty miles. The upper part of the bay has many rocky capes, numerous islands and shoals and is divided into two arms. A group of larger islands, containing Chase and Gabriel Islands, occupy the middle of the bay. The southeast coast of the bay (Kingaite side) is composed of high, rugged, barren, igneous hills indented by numerous fiords and partially covered by Grinnell Glacier, which discharges by way of several tongues into the bay. The general dip of the beds was found to be S. 70° E. and N. 70° W. The coast has all the marks common in a glaciated region, such as lakes, cirques, hanging valleys and deep fiords. In the valleys between the hills, lakes formed by the damming of streams by moraines, eskers and kames are not uncommon The physiography of the southwest coast is essentially the same, except that the hills are not so high and there is no existing glacier. The northeast coast of the bay is also a barren, rugged land, but does not show the work of ice as conspicuously as the other coast. Another contrasting feature of the northeast coast is that the hills are massive and seldom show any bedding planes.

Both coasts of the bay were examined as thoroughly as time permitted and collections of fossils were made at eleven different points. The fossils found on either coast of the bay were all drift fossils of Trenton and Utica stage and were doubtless brought to the coast from the interior of Baffin Land No sedimentary deposit in place, either fossiliferous or non-fossiliferous, was observed anywhere except at Silliman's Fossil Mountain, where the largest and best collection of fossils *in situ* was made This mountain is in 63° 43′ N. Latitude and 69° 02′ W Longitude. It stands at the head of the bay, about 300 feet from high tide and 2½ miles south of the Jordan River. It is a hill of limestone which lies unconformably on the hills of Meta Incognita. It is about three fourths mile long and 320 feet high (by aneroid) and runs in a general northwest and southeast direction.

All the fossils found here were of Middle Ordovician age (Trenton and Utica stage). They included the classes Brachiopoda, Lamellibranchia, Gastropoda, Cephalopoda, Trilobita and other Arthropoda, Echinodermata, Coelenterata and Porifera—the Cephalopoda being the most abundant. About 500 specimens were collected.

The only previous collecting known to have been carried on here was by two parties, one led by Captain C. F. Hall in 1862 and the other including Messrs. Carpenter, Porter, Shaw, White and Goodridge, of the

seventh Peary Arctic Expedition in 1897. Hall's collection was only a handful, consisting of twenty-seven species in all, but he was the first to make known the occurrence of fossils on the southeast side of Baffin Land. His collection is now in the museum of Amherst College The collection made by the five members of the Peary Expedition was better and larger than Hall's and numbered seventy-two species Part of this collection is now in the U S. National Museum and part in the American Museum of Natural History Dr Schuchert, of Yale University, described and figured this collection in his publication "On the Trenton Fauna of Baffin Land" The collection made by Mr Roy contains many species not listed by Schuchert and is believed to be the best and most complete assemblage of Arctic Trenton fossils that has yet been made From the observations and collections it is concluded that both sides of Hudson Strait, Frobisher Bay, Cumberland Sound and the interior of Baffin Land as far north as Ellesmere Land have but one fauna, namely, the Middle Ordovician fauna of Trenton and Utica stage.

GEOLOGY AT THE NASHVILLE MEETING OF THE AMERICAN ASSOCIATION

Section E of the American Association for the Advancement of Science (geology and geography) will hold its sessions at Nashville on Tuesday and Wednesday, December 27 and 28, in the geological lecture room at Vanderbilt University. The general headquarters for the section will be the Andrew Jackson Hotel, Deadrick Street and 6th Avenue. The stated price of single rooms at this hotel is $2.50 to $5.00

Tuesday will be devoted to a symposium on the Mesozoic-Cenozoic stratigraphy of the Gulf States At the morning session from 9 15 to 12:30 the mappable formations will be discussed by state geologists Florida, by Herman Gunter, of Tallahassee, Georgia, by S W. McCallie, of Atlanta; Alabama, by W B. Jones, of Tuscaloosa, Mississippi, by E N. Lowe, of Jackson, Louisiana, by W C. Spooner, of Shreveport, and Texas and southeastern Oklahoma, by E. H. Sellards, of Austin. Vice-president Charles Schuchert will present "The Paleogeography of North America during the Triassic and Jurassic." At the afternoon session, 2 00 to 5.30, correlations will be given by paleontologists L. W. Stephenson, "The Major Marine Transgressions, Regressions and Structural Features", T W Stanton, "The Lower Cretaceous or Comanchean Formations"; L. W. Stephenson, "The Upper Cretaceous or Gulf Series"; C Wythe Cook, "The Cenozoic Series East of the Mississippi River"; Julia A. Gardner, "The Cenozoic Series West of the Mississippi River on the Basis of the Larger Fossils"; F. B. and H. J. Plummer, "The Midway Correlations on the Basis of the Foraminifera"; E. W. Berry, "Correlations on the Basis of Fossil Plants", O. P. Hay, "Correlations on the Basis of Fossil Vertebrates." A smoker for Tuesday evening is tentatively planned.

On Wednesday one or two sessions will be held for the reading of general papers. Titles accompanied by abstracts of not more than 250 words should reach the secretary not later than November 29. On Wednesday also the section will join with the Association of American Geographers in a symposium on "Problems of the Mississippi River" On Wednesday evening Section E will combine with the Association of American Geographers in a joint dinner, at which the addresses of the retiring president, M R Campbell (A. A. G) and the retiring vice-president, G H. Ashley (Section E), will be read

The railroads are offering reduced rates on the certificate plan and all who attend are urged to secure certificates when purchasing tickets.

G. R. Mansfield,
Secretary, Section E

U S. Geological Survey,
Washington, D C

SCIENTIFIC NOTES AND NEWS

The Nobel prize in physics for 1927 has been divided and awarded by the Swedish Academy of Sciences to Dr Arthur H Compton, professor of physics at the University of Chicago, and to Dr Charles T. R. Wilson, Jacksonian professor of natural philosophy at the University of Cambridge.

The Royal Society has awarded the Hughes medal to Dr. W. D Coolidge, assistant director of the research laboratories of the General Electric Company; the Davy medal to Dr. Arthur A Noyes, director of the Gates Chemical Laboratory at the California Institute of Technology, and a Royal medal to Professor J C. McLennan, director of the physical laboratory at the University of Toronto.

On the occasion of the celebration of the semi-centennial of the University of Colorado, twenty-three honorary degrees were conferred, including the doctorate of laws on Dr. Robert A. Millikan, director of the Norman Bridge Laboratories of the California Institute of Technology; on Dr. Roscoe Pound, dean of the law school of Harvard University, and on Dr. Melville F. Coolbaugh, president of the Colorado School of Mines, and the doctorate of science on Dr. S. C. Lind, director of the school of chemistry of the University of Minnesota, on Dr. Henry Sewall, professor of physiology in the University of Denver, and

on Dr. Milo S. Ketchum, dean of the college of engineering of the University of Illinois.

The medal of the Explorers' Club of New York has been presented to Dr Fridtjof Nansen, Polar explorer, by Laurits S. Swenson, American minister to Norway, in behalf of the National Geographic Society of America. The presentation was at a dinner at the American Legation in recognition of Nansen's Arctic achievements.

Dr Knud Rasmussen, the Danish Arctic explorer, had conferred upon him the doctorate of laws by the University of St Andrews on October 7.

Presentation of the cross of the Legion of Honor, awarded to Dr Isaac Abt, professor of pediatrics at Northwestern University, by the French government, was made at a special convocation at the medical school on November 4.

Dr Fred H Albee was decorated with the order of Commander of the Crown of Roumania at Bucharest on October 27, for his "contributions to the advancement of bone surgery" Dr Albee delivered a course of lectures in Bucharest on orthopedic surgery

H W Hardinge, president of the Hardinge Company, of York, Pa., has been awarded the Edward Longstreth medal by the Franklin Institute for his invention of a rotary air classifier.

The council of the Institution of Civil Engineers has made the following awards· The Howard quinquennial prize to Professor W. E. Dalby, in recognition of his researches on the strength and structure of iron and steel; the Indian premium to A W Stonebridge For selected engineering papers published during session 1926–27 A Telford gold medal to Sir E. Owen Williams (London), Telford premiums to Dr. E. H Salmon (London), R. S Cole (India), Dr. H. Mawson (Liverpool) and A H. Douglas (London), and a Crampton prize to D. M'Lellan (Glasgow).

M. A. Lacroix, professor of mineralogy at the University of Paris, has been made a foreign member of the Stockholm Academy of Sciences.

At the annual meeting of the American College of Surgeons, Detroit, on October 7, Dr. Franklin H. Martin, Chicago, was elected president-elect, and Drs. John Chalmers DaCosta, Philadelphia, and Herbert P. H. Galloway, Winnipeg, vice-presidents.

Dr. Lewellys F. Barker, professor emeritus of medicine of the Johns Hopkins University School of Medicine, was installed as president of the Interstate Postgraduate Medical Association of North America at the recent annual convention in Kansas City.

Professor D. D. Jackson, head of the department of chemical engineering at Columbia University, has accepted the chairmanship of the coordinating committee, which is in charge of the coming visit of English chemists and chemical engineers, members and guests of the Society of Chemical Industry.

At the recent meeting of the American Röntgen Ray Society in Montreal, Dr. Edward H. Skinner, Kansas City, Mo, was elected *president;* Drs. Ralph D. Leonard, Boston, and Lawrence Reynolds, Detroit, *vice-presidents*, Dr. John T. Murphy, 421 Michigan Street, Toledo, Ohio, *secretary*, and Dr William A. Evans, Detroit, *treasurer*

B. F. Dana, assistant professor of plant pathology and assistant plant pathologist in the Experiment Station at the State College of Washington, has accepted a position as plant pathologist in the Texas Experiment Station and is placed in charge of cotton root rot work on substation No 5 at Temple, Texas.

J. F. Brewster has resigned from the position of research chemist of the Louisiana Sugar Experiment Station, Baton Rouge, La., and has joined the staff of the sugar section, U. S. Bureau of Standards.

Dr. Russell B Tewksbury has resigned as head of the vital statistics bureau of the Pennsylvania state department of health and has been succeeded by Dr. George B L. Arner, formerly statistician in the U S. Department of Agriculture.

Dr. Damaso de Rivas, professor of parasitology, University of Pennsylvania School of Medicine, Philadelphia, goes to the new Pan-American Hospital, New York, as director of pathology The Pan-American Hospital was dedicated on October 16, the outpatient department opened on October 28.

The following appointments made to the staff of the London School of Hygiene and Tropical Medicine took effect on October 1: Reginald Lovell, to be research assistant in comparative pathology; Mrs. M. M. Smith, to be demonstrator in bacteriology; Miss H. M. Woods, to be assistant lecturer in the division of epidemiology and vital statistics. W. Rees Wright has been appointed to a temporary research post, to continue Dr. P A. Buxton's investigations on the biology of stegomyia

George C. Haas, agricultural commissioner in Austria and Germany for the U. S. Bureau of Agricultural Economics, will not resume his Berlin post. At his request an assignment has been given him in the division of statistical and historical research, where he will devote the major part of his time to the extension, development and correlation of the foreign work of the bureau. L. V. Steere, assistant economist, will act in

charge of the Berlin office until Mr. Haas's successor is appointed

THE malaria survey to be conducted during the coming year through the cooperation of the Jamaican government and the Rockefeller Foundation will be directed by Dr Mark F Boyd, director of the Rockefeller Foundation station for field studies in malaria at Edenton, N C

DR. D J MUSHKETOV, director of the Geological Survey, U S S. R, is visiting the United States to gather data on organization, administration, methods of work, publication, costs, etc, in connection with geologic work

PROFESSOR LEON W COLLET, professor of geology and formerly dean of the faculty of science at the University of Geneva, Switzerland, will fill Professor R A Daly's chair at Harvard University during the first half year and during this month will deliver a course of lectures at Princeton University

DR A C G. MITCHELL, of the California Institute of Technology, is spending the year in Gottingen in experimental research on atomic structure in the laboratory of Professor James Franck

DR TAGE U. H. ELLINGER has returned from Europe where he has been organizing the international corn-borer investigations, instituted under the auspices of the International Livestock Exposition, Chicago. Corn-borer research is under way at ten institutions in the following countries France, Germany, Hungary, Jugoslavia, Roumania, Sweden and Denmark. During his visit abroad, Dr Ellinger received from the King of Denmark the appointment and decoration as a Knight of Dannebrog

DR HUGH S CUMMING, surgeon-general of the U S Public Health Service, returned to Washington on November 8, after attending the eighth Pan-American Sanitary Conference in Lima, Peru Dr Cumming was reelected to his third term of three years as director Dr B J Lloyd, formerly assistant surgeon-general, will assist him, as heretofore, in the administration of his duties Dr Mario G Libredo, of Cuba, was elected vice-director. At the Peru conference, Dr. Cumming was elected a foreign member of the National Academy of Sciences of Peru

DR. WILLIAM H TALIAFERRO, professor of parasitology, Drs Lucy Graves Taliaferro and Frances A Coventry, research associates in the department of hygiene and bacteriology of the University of Chicago, have returned from months of research work in Central America Through the courtesy of the United Fruit Company they spent most of their time working on the serology and immunology of malaria and various intestinal worms at the hospital of the Tela Railroad Company in Tela, Honduras. Dr. Taliaferro has been invited to the school of tropical medicine of the University of Porto Rico to serve as visiting professor of parasitology during the winter quarter of 1928.

PROFESSOR WILLIAM H. HOBBS, of the University of Michigan Greenland Expedition, which left New York last June, returned to the United States on November 8 The expedition has established headquarters at Kangerglugouak Fjord, Greenland, to study weather conditions. Professor Hobbs left five of his associates at Kanderglugouak Fjord to remain until next spring continuing the observations

DR. W J SPILLMAN, economist, division of farm management and costs, U. S Bureau of Agricultural Economics, has returned to his work in the division after an absence of eight months, during which he studied the agricultural problems of the Indians of the United States

DR. E SEIDL, of Berlin, mining engineer and geologist, known for his studies of the salt domes and potash mines of central Germany, is visiting the United States

DR. LOUIS SHOTRIDGE, Chilkat Indian and assistant in the American section of the University of Pennsylvania Museum, has returned to Philadelphia after five years of ethnological research work in Alaska

DR. L. LAPICQUE, professor of physiology in the University of Paris, has been invited to give a series of lectures at the French-Brazilian Interchange Institute, Rio de Janeiro

DR. WHEELER P DAVEY, professor of chemistry at Pennsylvania State College, lectured before the Franklin Institute, Philadelphia, on November 10, on "Modern Research on the Structure of Metals."

PROFESSOR A H REGINALD BULLER, of the University of Manitoba, is giving a series of six lectures during the week of November 14, on the Norman Wait Harris Foundation of Northwestern University on "Recent Advances in our Knowledge of the Fungi, or the Romance of Fungi Life."

PROFESSOR JAMES E ACKERT, professor of zoology and parasitologist at the Kansas State Agricultural College, addressed the New Jersey State Poultry Association at Atlantic City on October 13 and the Delaware State Poultry Association at Dover on October 20 on "The Biology and Control of Intestinal Worms of Chickens."

DR. WILLIAM E. GYE, pathologist of the Medical Research Council, London, gave an address on "The

Cancer Problem" on November 8 before the Harvard Medical Society

DR. GEORGE R. MINOT, of the Harvard Medical School, delivered the eighteenth Mary Scott Newbold lecture at the College of Physicians, Philadelphia, November 2, on "The Treatment of Pernicious Anemia"

DR. C. MACFIE CAMPBELL, professor of psychiatry in the Harvard Medical School, will deliver the eighth Pasteur lecture before the Institute of Medicine of Chicago at the City Club on November 18 on "Some Problems of the Functional Psychoses"

THE Huxley lecture at the University of Birmingham is to be delivered on December 1 by Professor A S Eddington, Plumian professor of astronomy and experimental philosophy in the University of Cambridge

PROFESSOR MILTON WHITNEY, chief of the Bureau of Soils, U S Department of Agriculture, died on November 11, aged sixty-seven years

DR GLENN D KAMMER, assistant director of the radium research laboratory, Standard Chemical Company, died on November 7, aged thirty-nine years

DR G H BENJAMIN, industrial engineer of New York, died on November 10, in his seventy-fifth year

DR CHARLES E SIMON, resident lecturer on filterable viruses at the Johns Hopkins School of Hygiene and Public Health, has died at the age of sixty-one years.

JAMES H DORSETT, formerly collaborating agricultural explorer in the U S Bureau of Plant Industry and more recently associated with the National Geographic Society, died in Washington, D C, on October 8, aged twenty-seven years

SIR WILLIAM GALLOWAY, mining engineer, known for his pioneer researches into the action of coal dust in mine explosions, died on November 10

THERE will be an open federal competitive examination for associate chemist at a salary of \$3,000 and for a biochemist at a salary of \$3,600 Applications must be on file with the Civil Service Commission at Washington, D C, not later than December 6.

THE twenty-ninth annual meeting (the 148th regular meeting) of the American Physical Society will be held in Nashville from December 28 to 30, in affiliation with section B—physics—of the American Association for the Advancement of Science At the session in charge of section B, on Wednesday afternoon, December 28, Professor William Duane, the retiring vice-president and chairman of section B, will give the annual address on "The General Radiation." This will be followed by an address by Dr. C. J. Davisson, of the Bell Telephone Laboratories, who will speak on "Diffraction of Electrons by a Crystal of Nickel," a subject of great significance for the new quantum mechanics. This address will be followed by a discussion On the same afternoon at the general session of the American Association, Dr. E. W. Brown will deliver the Willard Gibbs lecture on "Resonance in the Solar System." On Thursday afternoon, December 29, Professor Karl T. Compton will deliver his presidential address on "Recent Studies of the Electrical Discharges in Gases" Accommodations for members of the Physical Society and of section B have been reserved in the Ward-Belmont School dormitories. Applications for reservations should be sent to Professor C. R. Fountain, care of Ward-Belmont School, Nashville, Tennessee, and should be mailed not later than December 15

THE twelfth annual meeting of the Optical Society of America was held at Union College, Schenectady, N Y, on October 20, 21 and 22 Features of the meeting were an address of welcome by President C E Richmond, of Union College, a complimentary dinner at the General Electric Company and an inspection tour of research laboratory and plant, an exhibit of optical apparatus by a number of dealers in optical equipment, a banquet at the Hotel Van Curler Of special interest were the invited papers, "On Cerebral Function in Vision," by Dr K. S. Lashley, on "Optics, the Key of Astronomy," by Dr. C G Abbot, and the presidential address by the retiring president, Dr W E Forsythe, on "Temperature Radiation" At the banquet an interesting demonstration was given by Dr. John B Taylor of the transmission of music over a beam of light. Eighteen scientific papers and reports were read. The following officers were elected for a term of two years, beginning January 1, 1928 *President*, I. G. Priest, *vice-president*, L. A Jones; *members of the executive council*, L R. Ingersoll, P. E. Klopsteg, W. F Meggers, A. H. Pfund.

IN addition to the fifteen papers to be presented at the organic symposium of the American Chemical Society at Columbus, Ohio, from December 29 to 31, there will be colloquia on the following subjects Suggestions regarding them should be sent to the chairmen in charge "Abstracting Organic Articles," E. J. Crane, *chairman*, Ohio State University, Columbus, Ohio, "Electronic Conceptions in Organic Chemistry," H. S. Fry, *chairman*, University of Cincinnati, Cincinnati, Ohio; "An Organic Experience Meeting," L. F. Fieser, *chairman*, Bryn Mawr College, Bryn Mawr, Pennsylvania; "Nomenclature of Organic Chemistry," A. M. Patterson, *chairman*, Xenia, Ohio; "Teaching Organic Chemistry," F. B.

Dams, *chairman*, University of Kansas, Lawrence, Kansas

On Saturday evening, November 19, the New York Microscopical Society will hold its fiftieth anniversary at the American Museum of Natural History The exhibition will consist of mounted objects under instruments, microscopes—ancient and modern, apparatus, accessories, books and other material of interest to the microscopist

The regular fall meeting of the New York section of the American Electrochemical Society will be held at Keen's Chop House, New York City, on November 18, at 6 30 p m Mr G A Anderegg, of the Bell Telephone Laboratories, will speak on "Submarine Cable Engineering"

The North American Committee on Fishery Investigations held its autumn meeting on October 19 at the University of Toronto The United States was represented by Dr H B Bigelow, of Harvard University, and Elmer Higgins and O E Sette, of the U S Bureau of Fisheries The haddock fishery was given particular attention. Study of the total catch made on this side of the Atlantic reveals that there has been, on the whole, little change since as far back as the eighties of the last century, though a slow increase since 1900 is evident.

On the occasion of the International Conference on Rabies, recently held in Paris, an International Society for Microbiology was founded, with Professor Jules Bordet, of Brussels, as president, and Professor Rudolf Kraus, of Vienna, Drs Dujarric de la Rivière and Plotz, of Paris, as secretaries

In the presence of leaders of European chemistry, M Herriot, minister of public instruction, laid on October 26 the corner-stone of the International House of Chemistry, to be erected in Paris at a cost of 15,000,000 francs as a memorial to Marcelin Berthelot Jean Gerard, secretary-general of the French Society of Industrial Chemistry and head of the French committee in charge of raising funds, has succeeded in obtaining subscriptions from forty nations for the aggregate sum of 15,538,000 francs, 8,700,000 of which has been given by France The United States was the fifth largest contributor on the list with 583,400 francs

The will of the late William John Curtis, of New York City, provides $10,000 to the New York Otological Society for its research fund and $10,000 to the Johns Hopkins University Medical School. Bowdoin College will eventually inherit $55,000 from two trust funds established for the testator's sister

Through the generosity of his surviving colleagues, the photographic collection of the late Erwin F. Smith, of the U. S Department of Agriculture, has come into the possession of Science Service. The collection consists of more than 200 portrait negatives, largely of plant pathologists, but including a considerable number of portraits of historic value With the negatives were also a large number of photographic prints, partly from the plates and partly from other sources The work of cataloging negatives and prints is now going forward All of the original photographs, together with a complete set of prints from negatives, will be deposited with the library of the Department of Agriculture after they have been properly arranged and labeled The negatives will be retained by Science Service, and a special catalogue will be issued to enable interested persons to obtain such prints as they may desire.

UNIVERSITY AND EDUCATIONAL NOTES

A gift of $25,000 has been made to Harvard University by Mr George R Agassiz to endow a research fellowship for advanced students at the Harvard College Observatory

The Sloane physics laboratory at Yale University has purchased important additional equipment as a result of a gift of $26,000 made during the past year by Henry T Sloane, of New York City

The Rockefeller Foundation has given $1,640,000 to the department of medicine of the University of Lyons, which is being removed to the suburb of Monplaisir, close to Grange Blanche Hospital Of the remaining 15,000,000 francs required, Premier Poincaré and Minister of Instruction Edouard Herriot have promised to supply 12,000,000 francs in three instalments from government appropriations, the university will supply 1,500,000 francs and prominent citizens of Lyons will be asked to donate the remainder

Dr. William H Cole, professor of biology at Clark University, has been appointed professor of physiology and biochemistry at Rutgers University, where he will begin his work on February 1 His associate, Dr Allison, will offer the courses in biochemistry

John Wolfenden, a graduate at Oxford and last year a fellow of the Commonwealth Fund at Princeton University, has become acting assistant professor of chemistry at Oberlin College

Dr. John Beattie, recently prosector in the Zoological Gardens, London, England, has been appointed assistant professor of anatomy at the University of Montreal.

R. Herbert Edee has left Northwestern University

to become professor of organic chemistry at Hamline University, St Paul, Minnesota.

EDWIN H SHAW, Jr, has been appointed assistant professor of biochemistry at the University of South Dakota, Vermillion, S. D

DR H C JACKSON, associate dairy manufacturing specialist of the Bureau of Dairy Industry, at present in charge of the department's experimental work at the Grove City creamery, has accepted appointment as head of the dairy department in the College of Agriculture of the University of Wisconsin

R R MCKIBBIN, assistant professor, soils department, University of Maryland, has been appointed lecturer in the department of chemistry in Macdonald College, Quebec, Canada.

ASSISTANT PROFESSOR W W ELLIOTT has been promoted to a professorship of mathematics at Duke University

PROFESSOR ZWAARDEMAKER, occupant of the chair of physiology at the University of Utrecht, has resigned his post, having reached the age limit He will be succeeded by Professor Noyons, of Louvain, Belgium

DISCUSSION AND CORRESPONDENCE

A COMMUNICATION ON THE MAGNETO-OPTICAL EFFECT AND A CORRECTION

THIS article concerns the Magneto-Optical Effect, described by me in SCIENCE (N S Vol LIII, No 1382, pp 565 to 569, June 24, 1921) and *Nature*, June 23, 1921, which was at that time a novel discovery or observation. The description was later followed by a statement of "Further Investigations," (SCIENCE, N. S Vol. LIV, No 1387, pages 84–85, July 29, 1921).

In the first place, I desire to make a correction in the latter communication, where it is stated that the "flickering observed appears to keep time with the *cycles* and not with the *alternations of current*" This is an error, as it was found later that in reality the described fluctuations do indeed follow the alternations, the mistake being due to misinformation as to the cyclic rate

It may be desirable here to describe briefly the original phenomena, adding comments which relate to more recently observed facts. A magnetic field produced by a direct current, permanent magnet, or by interruptions or alternations of current is rendered visible even when very weak, by a light smoke from an iron arc. Such fume or smoke is effective for the purpose even when so thin or diffused as to be scarcely noticeable in the air. Such smoke, too, diffused in the space where a field exists, when illuminated from above by sunlight or an artificial source, and viewed in a direction across the light beam, and more or less normal to the direction of the lines of force of the field apparently becomes luminous. In reality it becomes a far better reflector or diffuser in certain directions of the incident light than when the field lines are absent Viewed along the magnetic lines no increased luminosity is produced even when the field is strong or the illumination strong, or both.

The conditions for its observation seem to be—

1 Illumination transverse (more or less) to the direction of the lines of force of the field.

2 Viewing in a direction more or less transverse to the lines of the field and to the direction of the incident light

The amount of iron smoke in the air required to produce a very noticeable effect seems to be very small, although density of the smoke increases greatly the contrast between what is visible when current or field is on, and when no magnetic field exists Indeed, without the presence of the field the smoke from the iron arc may be practically invisible The illumination from the smoke particles was found to be polarized as if produced by reflection from strings of fine particles, oriented in the direction of the field lines These particles are exceedingly small, almost beyond ordinary high powers of the microscope, and the striated ferric oxide, which it seems to be can be caught on a microscope slide while the magnetic field is on, and studied under high powers

The remarkable thing is the small amount of the iron smoke needed to produce the effect and the instantaneous response to very weak fields Thus, if an open coil or helix without a core of iron be traversed by a fluctuating or slowly alternating current, the flickering may be shown by a detector constituted by holding the open neck of a glass flask over an iron arc for a few moments Some of the smoke enters the flask, which can then be corked Such a flask has shown flickering at a distance of twelve feet away from a small coil, through which a low frequency current was sent And, curiously, when the flask was placed near the coil the flickering was replaced by a steady illumination. When gradually removed from the coil in the direction of its axis, the flickering became more and more pronounced

This indicates that the orientation or arrangement of the particles to correspond with the field lines, takes place with a weak field, and almost instantaneously in a strong alternating field, in the latter case, being accomplished and maintained throughout the whole wave of current. The zeros seem to be without effect in arresting the appearance, while at a considerable distance away from the same coil, excited as before, the weaker field at such a distance

can only orient the particles at or near the maximum of the current waves. This seems to indicate that a certain very low value of the magnetizing force is sufficient for the orientation or alignment of the particles. Retention of vision by the eye may also cover up any very short interruptions in the luminous effect itself.

Use has been made, since the publication of the original descriptions, of the new effect for rendering visible to the eye a rotating field produced by biphase, three phase, or polyphase currents. The effect is unique, and naturally quite interesting. It can be photographed.

If we provide a box with a glass front and back and means for introducing the iron arc smoke, a beam of light sent in from the back with no excitation or magnetic field present, there is no marked result. We may now place on the box a coil lying flat on the top and conveying current. In this case there is clearly displayed a luminous effect; the field of the coil has been depicted. In each case, of course, iron arc smoke has been within the box at each trial. It can be allowed to enter through a hole at the bottom of the box provided therefor.

It is surprising, too, how long a time it takes for the fumes to settle out of the air within the apparatus.

We have constructed a device for rendering visible a rotating field, such as that of a three-phase motor. The structure is, in fact, a three-phase field winding, as in a motor. As the ordinary frequencies would be too high for observation, there is provided a small motor driving at reduced speed a small generator of the three-phase currents needed for the excitation of the field. Usual arrangements are provided for varying the speeds, and thus the cyclic rate or frequency of the currents in three-phase winding. The open field space, as in an alternating current motor with the rotor removed, is arranged with glass ends so that it may receive and retain iron arc smoke. In this way, the revolving field inside the structure becomes distinctly visible as a luminous glow revolving within it.

The direction of revolution may also be instantly changed by the switches provided for reversing two of the phases, and the speed of revolution of the field may be made slow, or so fast that retention of vision results in a continued interior luminosity.

It is probable that with further development such arrangements may be designed as to make use of this magneto-optical phenomenon in the study of distortions in alternating fields by the introduction of closed circuits in the form of rings, plates and various forms of conductors, or even to compare the distortions produced by the material as well as the form of conductors in alternating fields. Perhaps, also, the distortions of field lines produced by revolving or moving conductors even in direct current fields may be exhibited or investigated. My time has not permitted such work, interesting as it may be, to be carried on.

ELIHU THOMSON

THE EUROPEAN LARCH CANKER IN AMERICA[1]

IN April, 1927, members of the Harvard Forest School brought to the senior writer's attention specimens of a trunk of European larch bearing several cankers in the thin smooth bark of the younger parts. The appearance instantly suggested the European larch canker disease and it was quite evident that it was acting as a parasite. Fortunately perfect fruiting bodies were present and the fungus was found to agree in general with the microscopic characters published for *Dasyscypha calycina* (Schum.) Fuckel. Examination of the plantation from which the specimen came showed abundance of cankered trunks and branches. The fungus occurred on dead twigs and branches as well as on living bark of younger parts of the trees. Since that time investigations have been carried on to determine how serious the disease is, and how extensively it is distributed in that vicinity. It has been found attacking European larch (*Larix europaea* DC.), Japanese larch (*L. leptolepis* Gordon), eastern American larch (*L. laricina* (DuRoi) Koch), Douglas fir (*Pseudotsuga taxifolia* (LaMarck) Britton), pitch pine (*Pinus rigida* Miller) and Scotch pine (*P. sylvestris* Linn.) and on four different estates situated in the three towns, Hamilton, Ipswich and Danvers, Massachusetts. In Europe it is reported to attack the additional species which are native or generally introduced here, *Larix occidentalis* Nuttall, *L. sibirica* Ledebour, *Picea excelsa* Link, *P. sitchensis* Carrière, *Pinus nigra austriaca* Asch. & Graeb., *P. cembra* Linnaeus, *P. laricio* Poiret, *P. mugho pumilio* Zenari and *Abies pectinata* DC. The origin of the disease is quite conclusively indicated by the fact that the European and Japanese larches on two of the estates were imported as seedlings from Scotland in 1904 and 1907. Old cankers are located within a foot of the ground on wood which must have been formed when the trees were imported. Some of the diseased Douglas fir is also known to have been imported as seedlings. The amount of infection in European larch runs up to one hundred per cent. of the trees, Japanese larch is relatively resistant, but Douglas fir infection near diseased European larch is about eighty per cent., with

[1] Published by permission of the U. S. Secretary of Agriculture.

numerous cankers similar to those on the larch. There is no reason to suppose that this locality is the only one where the disease occurs; indeed the reverse is practically sure to be the case, as it is well known that European larch was imported widely and quite generally twenty to fifty years ago The fact that it can go onto so many different American species, which are important timber trees, makes this discovery of very serious importance to all parts of this country Further scouting is being done to see if it is widely distributed

PERLEY SPAULDING,
PAUL V SIGGERS
BUREAU OF PLANT INDUSTRY AND
NORTHEASTERN FOREST EXPERIMENT STATION

THE DEFICIENCY OF ENGLISH UNITS OF MEASURE AND WEIGHT FOR SCIENTIFIC AND TECHNICAL USES

THERE are certain deficiencies in the English measures and weights which may be ascribed to historical causes and which have been imperfectly supplied by the use of troy and metric small denomination units But the troy and metric units are not commensurable with the common or English units The cause of this deficiency is that the English units were developed for the uses of trade, construction and manufacture, to which purposes they are perfectly adapted The demand for technical, scientific and precision units is a relatively modern demand.

The English measures have no unit lower than the inch, whereas the metric system has seven such units, *viz.*, centimeters, millimeters, microns, angstroms, millimicrons, milliangstroms and micromicrons, of which the inch contains 2 54 centimeters, 25 4 millimeters, 25,400 microns, 254,000 angstroms, 25,400,000 millimicrons, 254,000,000 milliangstroms and 25,400,000,000 micromicrons.

Likewise the English weights have no unit lower than the ounce, whereas the troy and metric weights have 12 such units, *viz*, drams, pennyweights, scruples, grams, carats, metric carats, decigrams, grains, centigrams, milligrams and micrograms, of which the ounce contains 7 2916 drams, 18 229 pennyweights, 21.875 scruples, 28.3502 grams, 138.449 carats, 142.045 metric carats, 437.5 grains, 2835 02 centigrams, 28,350.2 milligrams and 28,350,200 micrograms

To supply the deficiency of our common units in the field of technical and scientific measures and weights, it is proposed that the foot be divided on the decimal scale into 100 lines and 1,000 points and that the ounce be divided into 8 drams, 100 centos and 1,000 moits, the ounce being the cube of the tenth of the foot, the dram the cube of the twentieth of the foot and the moit the cube of the hundredth of the foot of water at the maximum density. The common eight-ounce cup is the cube of two tenths or of one fifth of the foot This will supply the deficiency of common units lower than the inch and the ounce, made necessary by modern refinements in measuring dimensions, volumes and masses.

For definitive purposes it is proposed that the foot be taken as the length of 473,404 waves of red cadmium light, that the ounce be taken as the weight of 28,316 milligrams and that new material standards or master bars and weights be constructed from these definitive values

The avoirdupois pound was anciently regarded as equal to 7,002 troy grains In 1844, however, after the burning of the parliamentary standards, the pound for the sake of certainty was defined by parliament as the weight of 7,000 troy grains, which produces 437 5 grains to the ounce

The proposal to define ounce as 28,316 milligrams recognizes 28,316 grams as the weight of the cubic foot of water under the definition of the foot as 473,404 red cadmium waves This takes 34 milligrams off the ounce, which for practical purposes may be regarded as one-half grain of 32 4 milligrams, thus reducing the ounce roughly from 437½ to 437 grains.

It is quite as legitimate to give the ounce a definition in milligrams as it was to give the pound a definition in troy grains, as was done more than eighty years ago This is the one way to coordinate the ounce with the cubic foot of water and to correlate common volumes and weights

SAMUEL RUSSELL
WASHINGTON, D C.

"WASHBOARD" OR "CORDUROY" EFFECT DUE TO THE TRAVEL OF AUTOMOBILES OVER DIRT ROADS

THE interesting account of the so-called "washboard" or "corduroy" effect due to the travel of automobiles over dirt roads calls to mind an experience which the writer had last summer in the northern part of Minnesota.[1] Professor Dodd's explanation is very much to the point and on the whole I think plausible, but I am not sure that the explanation has gone far enough. In the single instance observed, my motor car was following a "grader" over a newly graveled stretch of road and, since I had myself advanced several theories concerning the cause of this

[1] Dodd, L. E., "'Washboard' or 'Corduroy' Effect Due to the Travel of Automobiles over Dirt Roads," SCIENCE 66, 1927, 214–216.

frequent phenomenon, I was very much interested to see that my theories were wrong, especially at the beginning of the causal series Many of the corrugations that I had noticed were somewhat slanting, and now I saw that the scraping blade of the grading machine was responsible for the original vibration which was left in the road

I have no doubt that the wheels of cars which travel on newly graded roads very much deepen these ridges when they resonate in tune to the original vibration of the scraping blade of steel which has left its marks in the ridges on the road It must not be forgotten, too, that rain falling on the road will then also tend to drain off along these ridges and deepen them by erosion I am wondering, too, when the road is of a certain elastic consistency, with a slight amount of moisture in the top layer, whether it will not then act much in the same fashion as the black asphalt pavements do when they are corrugated by impact, especially on down grades

Naturally, this was only a single instance that came under my observation, but I made sure that there were no corrugations in front of the grader and that there were characteristically slanting and partially formed ones behind, and I am offering this bit of discussion in the hope that the matter may be verified or contradicted by observations of others In general, this additional cause does not contradict the excellent explanation of Professor Dodd, but goes simply one step farther in certain cases

CHRISTIAN A RUCKMICK
THE UNIVERSITY OF IOWA

THE SEARCH FOR ELEMENTS ESSENTIAL IN ONLY SMALL AMOUNTS FOR PLANT GROWTH

FOR many years the essential nature of certain elements for normal plant growth remained undiscovered because they are needed in such small amounts that they were supplied as undetected impurities in the media in which the plants were grown Between the years 1910 and 1919 Mazé,[1] by careful technique, showed boron, zinc and manganese to be essential to the growth of maize Possibly because most of his papers were published in a journal devoted chiefly to bacteriological literature, they were overlooked by most plant physiologists It was not until 1922 that the work of McHargue[2] emphasized the essential nature of manganese.

Boron was the next of these elements to receive attention Warrington[3] in 1923, showed it to be essential for broad beans (*Vicia Faba*) and probably for runner beans, crimson clover (*Trifolium incarnatum*) and *Trifolium multiflorus*, but reported inconclusive results for white clover (*Trifolium repens*) and peas and negative results for barley and rye The writer[4] in experiments with silicon and aluminum in which purified salts were used, confirmed the results with broad beans The "mason" jars in which the solution culture experiments were being carried out were coated with "Valspar," a resistant varnish, to prevent contamination by solution of the glass, and sufficient boron for apparently normal growth of wheat, peas, millet and *Penisetum vilosum* was furnished by the varnish Broad beans, however, made very little growth and showed the symptoms described by Warrington They made remarkable recovery and normal growth when 5 mg per liter of boron as boric acid was added to the solution Later on when using uncoated jars in an experiment to determine whether or not chlorine is essential to plant growth, buckwheat failed to develop beyond the cotyledon stage when purified salts were used but developed normally when the ordinary "C P" analyzed salts were employed Because of the experience with broad beans, absence of boron was suspected of being the limiting factor Investigation showed this to be the case This and the effect of boron on the growth of sunflowers led the writer to study the effect of the absence of boron on a number of plants Part of this work[5] with that continued at the University of California and later at the University of Minnesota, showed boron to be essential to corn, peas, sunflowers, vetch, barley, buckwheat, dahlias, lettuce, potatoes, millet, castor beans, sugar beets, kafir, sorghum, flax, mustard and pumpkins Plants differed in the time, and to some extent in the way, in which the effect first appeared but none of the plants reached the flowering stage. Dicotyledonous plants in general responded more quickly than did monocotyledonous plants. In the case of sunflowers, cotton and buckwheat, the tops did not develop beyond the cotyledon stage and the roots grew very little Other dicotyledonous plants showed the lack of boron by suppressed roots with enlarged apices within a few days but, depending on the type of plant, produced from

[1] Mazé, P *Ann Inst Pasteur* 1914, 28, 21–68, 1919, 33, 139–173 *Comp Rend Acad Sci.* 1915, 160, 211–214

[2] McHargue, J S *Jour Amer Chem Soc* 1922, 44, 1592–1598

[3] Warrington, Katherine. *Ann. Bot.* 1923, 37, 629–672

[4] Sommer, A L *Agri. Sci Series*, Univ California. 1926.

[5] Sommer, A. L. and Lipman, C. B. *Plant Phys.* 1926, 1, 231–249.

two to eight leaves. Soy beans were an exception; neither the tops nor the roots showed the effects of the lack of boron for two weeks In this case also the roots were the first to show the effect Monocotyledonous plants grew for a greater length of time and produced much better root systems than did the dicotyledonous plants Many of these plants showed abnormal tillering as well as withering of the growing points of the tops Corn showed the effects of the lack of boron in a week, but continued to produce small tillers for some time Barley, under winter greenhouse conditions, apparently grew normally for a month, but after that the difference between the plants without boron and the controls developed rapidly Bermuda grass (the only plant investigated which did not show marked injury in the absence of boron) is still under investigation, and so far has given very doubtful results It is a very resistant grass and after an initial addition of iron to the culture solution, grew well and with no signs of chlorosis, without further additions of iron, during a period of two months while the writer was absent

It is interesting to note that in a recent paper by Brenchley and Warrington,[6] buckwheat and potatoes are among the plants reported to have given inconclusive results and that peas completed normal development without boron These results, as well as some reported in Warrington's earlier paper, are in marked contrast to those obtained by the writer Whether this is due to a difference in technique or to the amount of boron stored in the seed is a point still to be investigated, but the fact that these authors obtained better growth without the addition of boron when they changed the solutions frequently suggests that the salts which they used may not have been entirely free from boron In the case of the potato, the writer did not use seeds but allowed the tubers to sprout, removed the sprouts and transferred them to culture solutions

Zinc, of the three elements mentioned above, is the one in which the conditions of experimentation must be most carefully controlled The ordinary glass "mason" jar, in which many solution culture experiments are carried out, apparently furnishes all the zinc the plant needs It was not until an attempt was made to use pyrex beakers with purified salts that the need of zinc was suspected Solutions of the same salts which had produced good plants in ordinary glass failed when pyrex was employed Wheat grew well for about two weeks and then stopped growing, turned yellow and finally died. The roots on the other hand were in good condition when the tops were dry and apparently dead. The analyses published by McHargue[7] in which zinc was found in seeds led the writer to try zinc which was found to be the limiting factor It was not until the experiments with barley and sunflowers were completed that the paper by Mazé, in which he showed zinc to be essential for maize, was discovered in the literature As in the case of the lack of boron, recovery from the lack of zinc can be accomplished by the addition of 5 mg of the missing element per liter to the culture solution Smaller quantities may be sufficient, but were not tried

Zinc was shown to be necessary for barley, sunflowers, wheat, buckwheat, broad beans and red kidney beans Buckwheat, sunflowers, barley and wheat showed the effects of the absence of zinc in the early stages of growth, wheat and barley died in the early stages, while some of the sunflowers and buckwheat plants, although much smaller than the controls, produced a few small flowers The broad beans and red kidney beans without zinc appeared to grow as well as the controls until they reached the flowering stage At this stage, the plants declined rapidly, most of the leaves fell off and only a few flowers on the broad beans developed No seed was produced by the plants without zinc, while those with zinc developed normally

When pyrex glass was used, silicon and aluminum, and later traces of other elements, including copper, were added to the solution Barley failed to make good growth in pyrex containers unless silicon was added and there was some indication that copper is also necessary

A study of these problems has shown that it is only by exercising the greatest precautions that we may solve the problem of essential elements The salts must be repeatedly crystallized from pure distilled water (essentially conductivity water) and in some cases be derived from elements and acids or from other salts, for the "C P" salts of trade usually contain, as impurities, sufficient amounts of certain elements to produce normal plant growth Contamination by dust and in some cases other impurities in the air (for example, chlorine, in chlorine studies) must be carefully avoided The type of container is also an essential factor. The ordinary glass jar must be avoided in many cases because of its solubility Pyrex is suitable for most work, and, although a boro-silicate, does not yield sufficient silicon and boron for the normal growth of at least some plants. The effect of the lack of boron, how-

[6] Brenchley, W. E. and Warrington, Katherine. *Ann. Bot.* 1927, 41, 167–187.

[7] McHargue, J. S. *Jour. Amer. Soc. Agron.* 1925, 17, 368–372.

ever, appears more slowly than when ordinary glass is used. Containers other than glass will probably have to be employed before the whole problem of essential elements is solved

A. L. Sommer

University of Minnesota

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A CONTAINER FOR FIELD COLLECTION OF MOSQUITO LARVAE

In the prosecution of malarial or mosquito studies larval collections play no small part Containers used for captured larvae are subject to various disadvantages For example, if the collecting jar is kept closed during field operations, the cover or cork must be removed whenever specimens are transferred to the container. If left open the contents are often lost because of jarring, especially if one is collecting in an area of irregular topography Furthermore, most containers used for this purpose have either no mechanism for their attachment to the belt, or only an inadequate arrangement The apparatus described below was devised to overcome the disadvantages just cited

The container is a four-ounce jar with a mouth diameter of 40 mm. Two glass tubes with inner diameters of 4.5 mm and 1.5 mm. run vertically through the rubber stopper as shown in the illustration. The outer termination of the former is flared

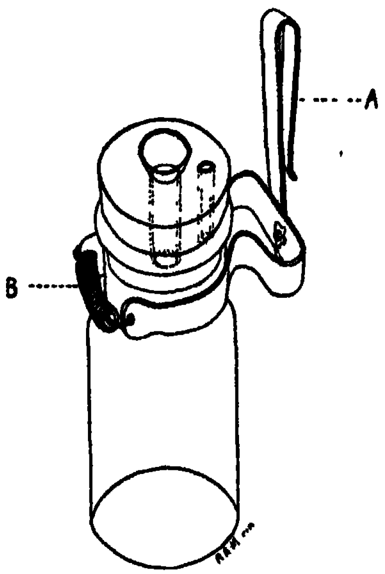

Fig 1

into a funnel with a maximum diameter of 15 mm. and height not exceeding 10 mm. The inner end is flush with the surface of the stopper. The shorter the height of the protruding funnel the less will be the risk of breakage. The widened portion facilitates the transfer of larvae from the dipper in which they were captured, to the receptacle, by means of a pipette. The smaller tube practically prevents the formation of air bubbles in the larger. Its inner termination extends slightly beyond the stopper to prevent particles of the rubber cork from filling the tube and thus hindering air circulation.

The bent portion (A) made of nickel plated metal served to hold a key ring to a belt. It is now used for a similar purpose except that it is riveted to the collar, a piece of spring steel 13 mm wide, so constructed that the jar is held tightly in place when its neck is enclosed within the collar. A hook similar to that shown in the illustration, except that it extended upward from the lower part of A, was cut off to better adapt the remainder for the design in view The coiled spring (B), while not necessary, renders slipping of the jar impossible. All metallic parts should preferably consist of rust resisting material.

The apparatus after several months' trial in Porto Rico has proven fairly satisfactory. It is hoped that this descriptive note will stimulate others to improve the present model.

Wm A. Hoffman

School of Tropical Medicine of the University of Porto Rico, Under the Auspices of Columbia University, San Juan

DECALCIFICATION OF BONE IN ACID FREE SOLUTIONS

In attempting to develop a method for the determination of an orthophosphate in bone, one of us observed that tertiary calcium phosphate is dissolved on addition of an excess of a magnesium citrate reagent even in the presence of a large excess of concentrated ammonia. White,[1] some four years ago, suggested the use of a solution of ammonium citrate for removing the lime salts from bone and the solvent action of the magnesium citrate reagent upon tertiary calcium phosphate suggested to us its possibilities as a decalcifying agent for histological purposes. The attempt to decalcify osseous tissue by means of this reagent proved successful.

The reagent is prepared as follows: Dissolve 80 gm of citric acid in 100 cc of hot water Add 4 gm of magnesium oxide and stir until dissolved. Cool, and add 100 cc of ammonium hydroxide (density 0 90). Dilute to 300 cc, let stand 24 hours and filter. (If the magnesium oxide contains much carbonate, it

[1] White, C P., *Jour. of Path. and Bact.*, Vol. 26, No. 3, 1923.

should be freshly ignited.[3]) The solution remains clear for some time and on standing, more rapidly after agitation, crystals of ammonium magnesium phosphate make their appearance.

Titrate with 5/N HCl to a reaction of approximately pH 7.0–7.6 and add an equal volume of distilled water

Procedure and results.—This decalcifying fluid is apparently efficient in softening bone after it has undergone the action of any of the common fixing agents, but it is perhaps better to fix and harden the specimen in formalin The latter must be well washed out from the tissue, first in running water for 12–24 hours according to the size of the specimen, and then in two or three changes of distilled water It is then ready for decalcification. The citrate solution should be changed fairly frequently, since it will otherwise dissolve the calcium salts to saturation and the reaction will then retard. It has seemed best to replace the solution every other day Decalcification proceeds relatively slowly as compared with solutions of the strong acids such as hydrochloric or nitric but it is much more rapid than Muller's fluid, picric or chromoacetoosmic acid, for example. The rib of a dog split through the center is freed of lime salts by this solution in about fifteen days Swelling of the tissues is not induced by the fluid and there is no apparent shrinkage of such cells as those of the bone marrow Stains are taken up without difficulty and sections stained with haematoxylin and Eosin colored in tints much more pleasing to the eye than those obtained when the application of the stain has been preceded by decalcification with strong acids Magnesium citrate solutions are not so satisfactory as is Muller's fluid, however, if determination of the amount of uncalcified osteoid tissue present in the bone during the life is requisite Unlike Muller's fluid, magnesium citrate allows decalcification to go on to completion and removes all possibility of distinguishing the osteoid tissue from bone which in life contained deposits of lime

Conclusions. 1. Bone may be completely and rapidly decalcified by means of a reagent which is neutral or alkaline and is free of acids. 2. This process leaves the remaining tissues in a satisfactory degree of preservation

B KRAMER,
P. G SHIPLEY
THE JOHNS HOPKINS HOSPITAL

[3] This reagent has been used by Mathison, G C, *Biochem Jour*, 1909, IV, 237, Fiske, C H., *Jour. Biol Chem*, 1921, XLVI, 289, and by others.

SPECIAL ARTICLES

E.M F. INDUCED IN A STRAIGHT WIRE BY A CURRENT IN A PARALLEL STRAIGHT CONDUCTOR

IN Figure 1, let A be a cross-section of a tubular conductor of practically infinite length, and let a current, i, in this conductor flow "in," as shown by the crosses Another long conductor, B, of small cross-section, is placed along the geometrical axis of A, and the ends of B are left open It is required to compute the e m f induced in B, per unit of its length, when the current in A varies with time at the rate di/dt

Reasoning I The magnetic lines of force outside the tube A are concentric circles, such as H Within the wall of the tube they are also concentric circles Inside the tube, the magnetic flux density is zero at any value of i Consequently, no flux cuts B or collapses on it when the current i is varied, and no e m f is induced in B

Reasoning II Consider two diametrically opposite filaments of current, such as f and f′, and determine the e m f which a varying current in these filaments would induce in B. The three conductors are shown separately in Fig 2 Let h be a line of force due to f, and h′ a line of force due to f′. Let the currents in f and f′ decrease, the motion of the two fluxes is then as shown by the horizontal arrowheads, each flux "collapsing" towards its own conductor. With

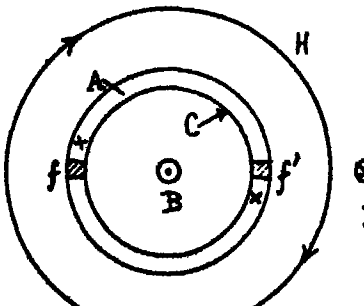

Fig. 1.

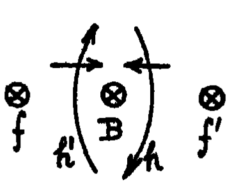

Fig. 2.

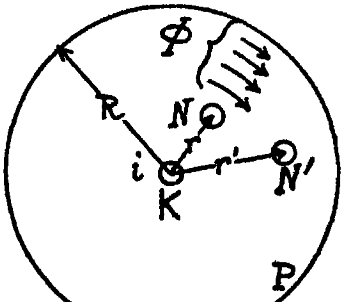

Fig. 3.

the polarities shown, the direction of the e.m.f. induced in B is "in," as indicated by the cross, the filaments f and f′ acting concurrently. This agrees with the general law that when the primary current decreases, the secondary induced e m f is in the same direction as the primary current

The tube A may be considered as consisting of pairs of filaments, such as f and f′ Since an elementary e m f is induced in B by each pair of filaments, and the action is cumulative, a finite e m f should be induced in B when di/dt in the whole tube has a finite value.

Thus, according to Reasoning I, there should be no e.m f induced in B, while according to Reasoning II, there should be an induced e m f of finite value Before unraveling this seeming paradox, the following propositions should be considered

(1) Is it legitimate to speak of an e m f induced between the open ends of a long straight conductor? To measure this e m f it would be necessary to introduce leads to a voltmeter, thus forming a closed circuit. If an electrometer be used instead, the circuit would still be closed through electrostatic lines of force within the instrument Should the leads and the measuring instrument be placed within the tubular conductor A, there should be no indication when the current i is varied Should the instrument and the leads be placed outside A, a loop would be formed, linking with some of the external flux H, and the induced e m f would depend upon the total flux enclosed by the loop.

(2) Careful writers do not speak of an e m f induced in an open straight secondary conductor, but of the direction of the secondary current, This implies a closed secondary circuit and avoids the vexed question as to the seat and location of this e m f See, for example, J C Maxwell, *Electricity and Magnetism*, Vol II, p 178, Foster and Porter, *Electricity and Magnetism*, p 394

(3) In Fig 3, let K be a straight infinite conductor carrying a current i Let N be a parallel secondary conductor of finite length, with open ends, at a distance r from K Let the current i return through a cylindrical shell P of very large radius R.

The lines of force due to i are concentric circles, and the flux Φ, comprised between N and P, per unit of axial length, is proportional to i log(R/r) Should i vary at the rate di/dt, the e.m f induced in N, per unit length, would be proportional to (di/dt) log(R/r) But R is arbitrary and tends to infinity, so that the e m f induced in N seems to be indefinitely large Here again, to measure this e m f, the circuit of N would have to be completed, for example by means of a parallel wire N′, at a distance r′. The flux enclosed in this secondary loop has a finite value, proportional to i log (r′/r), and the e.m.f. induced in the loop (not in one of the conductors) has a definite value (finite) confirmed by experiment.

(4) If an e m f could be induced in a long straight secondary conductor, as shown in Figures 1 and 3, then by grounding one end and providing the other end with a sharp point, an intense local electrostatic field should be produced The existence of this field could perhaps be demonstrated by some delicate ionization experiment, Stark effect, etc. On the other hand, grounding one end would give a closed circuit, through displacement currents along lines of force between the sharp point and the ground, so that the experiment may not be conclusive

Thus, on the whole, it seems as though the foregoing paradox is based on the impossibility of either computing or measuring an e m f induced in an open conductor, without considering a return circuit of some kind, either conducting or through a dielectric. In view of the very fundamental nature of the phenomena and laws involved, it is hoped that other points of view will be contributed to this discussion

Vladimir Karapetoff

Cornell University

RATE OF VIRUS SPREAD IN TOMATO PLANTS

When a plant is inoculated at one point with a virus disease, at what rate does the infective principle diffuse itself to other stems, leaves or shoots? Assuming that the incubation period is constant—that symptoms will appear in a given time after the infective agent has reached any point—the appearance of symptoms in a succession in other portions of the plant distant from the point of inoculation ought to provide a measure of the rate of virus spread from the original inoculation point This observational method, however, relies on uniformity of growth in all parts of the plant and such uniformity may not exist, it further depends on the detection of symptoms at the same stage in their development, which is by no means a certain procedure

The more direct method of measuring the progress of virus in a plant system here outlined appears to avoid the disadvantages mentioned and to provide a means, accurate within certain limits, of measuring the rate at which the virus moves from part to part of the plant. The results of the short series of preliminary tests are here recorded largely for the purpose of calling attention to and illustrating the method, since the conclusions that might be drawn from the few cases under observation must necessarily be accepted as only a rough approximation to the truth.

Eight tomato plants in pots were grown in such a manner as to develop several horizontal branches, each

of which was bent and led under the earth in a secondary pot to encourage rooting and thus form a readily detachable second plant The rooting process was hastened by a partial cut between the original and secondary pots. There was thus produced a "colony" with all its units organically connected but capable of being separated at any time and in any fashion desired. The colonies were grown in a greenhouse under a close cheese-cloth cage The greatest care was taken throughout to avoid accidental infection through insects, handling, touching of leaves, watering, etc There is no evidence that any such accidental infection occurred anywhere in the series

When all secondary plants were well rooted but still attached to the parent plant a single shoot of the parent was inoculated with freshly expressed juice from tomato leaves showing marked mosaic A glass tube drawn to a capillary point was used for the purpose, pressure being supplied by means of a dropper bulb on the end Inoculations were made near the growing point

TABLE OF RESULTS INDICATING THE RATE OF SPREAD OF TOMATO VIRUS IN TOMATO PLANTS

Series of Colonies	Condition of all shoots twenty four days after inoculation date, 0 – healthy, X – mosaic: Inoculated shoot	Daughter plants separated from colony at specified intervals after inoculation date: 3 days	10 days	15 days	19 days	24 days
A	X	0	X	X	X	
B	0	0	0	0	0	
C	X	0	0	X	X	
D	X	0	0	0	X	X
E	X	0	X	X	X	X
F	X	0	X	X	X	XX
G	0	0	0	0	0	0
H	X	0	0	X	X	

After inoculation a single secondary plant was removed from each colony at intervals of three, ten, fifteen, nineteen and twenty-four days where the number of daughter plants was sufficient for such a series These isolated plants were kept under observation to see if mosaic developed

Twenty-four days after inoculation a record of the various series indicated that in two colonies (B and G) the inoculation had failed There was no sign of mosaic in the shoot originally inoculated or any of the daughter plants in either colony. In the remaining six all plants removed after nineteen days had marked mosaic symptoms on the young growth; in five of the six the disease had appeared in plants removed after fifteen days; and in three plants taken away after ten days the disease was also evident. None of the plants removed after three days had developed mosaic twenty-four days after inoculation.

It is evident from the above results that the infective principle was unable to pass from the point of inoculation beyond the place of separation in any case in three days, that in half the cases not more than ten days was required to traverse this distance, that in five out of six cases the virus had passed into the daughter plants in less than fifteen days, and that in only one case was a period of fifteen days insufficient. In this case the two plants removed after nineteen days were both affected by mosaic on the twenty-fourth day, so that if one allows for a suitable incubation period it is evident that the point of separation must have been passed near the fifteen-day period

The distances to be traversed by the virus in these colonies varied from eight to eighteen inches We may see from the above records that these distances were traveled by the virus in periods which might be something less than ten days or slightly more than fifteen days. We have no right to assume that a uniform advance was made during this period, but for purposes of expressing the rate of progress of the virus in concrete fashion it may be permissible to adopt the average rate in common usage for such purposes On this basis the transfer of mosaic virus appears to take place through the shoots of the tomato plant at a rate somewhere in the neighborhood of one to two inches per day or one to two millimeters per hour.

W A McCubbin,
F F Smith

Pennsylvania Bureau
of Plant Industry,
Harrisburg

FEEDING PLANTS MANGANESE THROUGH THE STOMATA[1]

Does manganese benefit plants mainly by increasing the oxidative power of the soil, as has been claimed by Skinner and Reid[2] or is its chief value as a promoter of enzyme activity within the plant, as stated by Bertrand?[3] McHargue[4] has demonstrated

[1] Contribution 354 of the R. I Agricultural Experiment Station, Kingston, R. I

[2] Skinner, J J, and Reid, F R., "The Action of Manganese under Acid and Neutral Soil Conditions." *U. S D. A Bull.* 441 1916

[3] Bertrand, Gabriel, "Sur l'intervention du Manganese dans les Oxidations provoqués par la laccase" *Compt. Rend. Acad. Sci.* (Paris) I 124 · 1032–1035

[4] McHargue, J S, "The Rôle of Manganese in Plants." *Jour. Am. Chem Soc.* 44. 1592–1594. 1922.

that it is essential for the normal development of many kinds of plants. Gilbert, McLean and Hardin[5] have found it to be a cure for lime-induced chlorosis of spinach and oats. Similar beneficial results have been obtained with tomatoes on lime soils in Florida, according to Schreiner and Dawson.[6] Unpublished data also show similar benefits to beets, lettuce, onions, corn and millet on neutralized soils

Since the need for manganese on neutralized soils appears to be so general with many kinds of plants it is worth while to know whether its action is mainly on the soil or within the plant itself. This question was answered in the experiment here described by supplying some chlorotic plants with manganese through the soil, and introducing it into the tissues of others directly through the stomata of the leaves This last was accomplished by an adaptation of the porometer, used by Darwin and Pertz[7] for studying stomata openings, and modified by McLean and Lee[8] for inoculating citrus leaves with canker organisms. The apparatus consisted of a small glass medicine-dropper tube with a rubber lip on the large end so that it could be pressed against a delicate leaf without causing injury The small end of the tube was connected with a rubber atomizer bulb so that air could be forced into it under pressure. Then the tube was filled with a dilute manganese solution, its open large end pressed downward on a leaf, and the solution pumped into the intercellular spaces through the stomata By using potted plants and tilting the pots on their sides, it was possible to inject the intercellular spaces of the leaves nearly full of the solution, then wash off with distilled water any surplus that might adhere to the leaves, without getting any of the solution into the soil

In this way the effects were noted of supplying manganese to chlorotic spinach plants into the leaves through the stomata and also of supplying it to the soil. Equally prompt benefits were observed by both methods of treatment.

For this test six Wagner pots, each filled with about 10 kilograms of neutralized soil, were planted to spinach on April 20. On May 17, the plants had two to three leaves each and were very chlorotic The pots were then arranged in pairs, each pair containing comparable plants. Then the plants in one of each pair of pots were treated with manganese sulphate solution The treatments were as follows

Pot No	79	150 cc solution of 50 p p m of manganese poured on the soil
" "	166	Control, no manganese
" "	15	Injected 50 p p m manganese solution into leaves of alternating plants, eight being injected, nine left untreated
" "	36	Control, no manganese
" "	78	Ten plants injected with 50 p p m. manganese solution, eight plants injected with 5 p p m. manganese solution
" "	62	Control, no manganese

On May 24, one week after treatment, the plants injected with 50 p p m manganese solution were greener than the control plants and showed the greatest improvement The plants injected with 5 p p m manganese solution and those receiving manganese through the soil were also greener than the control plants, but not equal to those receiving 50 p p m. On May 31, it was noted that the plants which received 50 p p m of manganese were greener, but smaller, than those receiving only 5 p p.m

On June 7, the plants were harvested and weighed green, with the following results.

Pot No.	Treatment	Number of plants	Green weight total	Green weight per plant	Per cent increase over control
			gm.	gm.	per cent.
79	50 p p m. manganese on soil	13	85	6.5	51
166	Control	13	56	4.3	
15	Injected 50 p p m. manganese solution	8	57	7 1	29
15	No treatment	9	49	5 4	
36	Control	11	60	5.5	
78	Injected 50 p p m. manganese solution	10	60	6 0	20
78	Injected 5 p.p.m. manganese solution	8	57	7.1	42
62	Control	19	95	5.0	

The average weight of the control plants was 5.1

[5] Gilbert, Basil E, McLean, Forman T, and Hardin, Leo J, "The Relation of Manganese and Iron to Lime-induced Chlorosis" *Soil Science* 22 437–446. 1926.

[6] Schreiner, Oswald, and Dawson, Paul R., "Manganese Deficiency in Soils and Fertilizers." *Jour. Ind. and Eng Chem* 19 400–404 1927

[7] Darwin, F, and Pertz, D F M., "A New Method of Estimating the Aperture of Stomata." *Proc. Royal Soc.* London, Ser B, No B569 136–154. 1911. Cited by Samuel F Trelease and B E Livingston, "The Daily March of Transpiring Power as indicated by the Porometer and by Standardized Hygroscopic Paper" *Jour. Ecol*, No 14 1 1916. Abstract in SCIENCE, New Ser., 43: 363 1916.

[8] McLean, Forman T., and Lee, H. Atherton, "Pressures required to Cause Stomatal Infection with the Citrus Canker Organisms." *Philippine Jour Sci.* 20: 309–320. 1922.

grams, and of the treated plants 6.6 grams, the average increase due to the manganese being 30 per cent

Manganese was apparently about equally effective whether injected into the tissues of the leaves or applied to the soil Also, the control plants in Pot 15, which alternated with the injected plants in the same pot, were benefited neither in weight nor appearance by the treatment of the adjoining plants So it is quite safe to conclude that this lime-induced chlorosis was cured by the action of the manganese within the body of the plant The changes brought about in the soils by additions of manganese may be beneficial, but such changes were clearly not necessary for the recovery of the spinach in these experiments, while the injection of manganese solutions into the plants was clearly beneficial

This method of injection of solutions into the leaf tissues through the stomata may be advantageously employed in the study of other diseases of plants suspected to be due to deficiency of soluble substances

FORMAN T MCLEAN

RHODE ISLAND STATE COLLEGE

SOUTHWESTERN ARCHEOLOGICAL CONFERENCE

ON August 29–31, 1927, there was held at the excavation camp of Phillips Academy, Andover, at Pecos, New Mexico, an informal gathering of workers in Southwestern archeology and related fields There were present C Amsden, Southwest Museum, Monroe Amsden, Southwest Museum, Lansing Bloom, Museum of New Mexico, K M Chapman, Museum of New Mexico, H S Colton, University of Pennsylvania, C B Cosgrove, Peabody Museum of Harvard, Harriet Cosgrove, Byron Cummings, University of Arizona, A. E Douglass, University of Arizona, Clara Lee Fraps, University of Arizona, Charlotte Gower, University of Chicago, O. S Halseth, Arizona Museum, M R. Harrington, Museum of the American Indian, E L Haury, University of Arizona; E. L. Hewett, Museum of New Mexico; Walter Hough, U. S National Museum; N. M Judd, U S. National Museum, National Geographical Society, A. V. Kidder, Carnegie Institution and Phillips Academy, Madeleine A. Kidder, A L. Kroeber, University of California; T F McIlwraith, University of Toronto; H. L Mera, Indian Arts Fund, Paul Martin, Colorado State Museum, S G. Morley, Carnegie Institution of Washington; Frances R. Morley; E. H. Morris, Carnegie Institution of Washington; Ann A. Morris, J. L. Nusbaum, National Park Service; Frank Pinkley, National Park Service; E. B. Renaud, University of Denver; Oliver Ricketson, Carnegie Institution of Washington; Edith B. Ricketson, F. H. H. Roberts, Jr., Bureau of American Ethnology; Linda Roberts; J. A. B Scherer, Southwest Museum; H. Shapiro, American Museum of Natural History, Leslie Spier, University of Oklahoma, Erna Gunther Spier; H J Spinden, Peabody Museum of Harvard, J B Thoburn, Oklahoma Historical Society, T T Waterman, University of Arizona, R. Wauchope, University of South Carolina.

The purposes of the meeting were: to bring about contacts between workers in the Southwestern field; to discuss fundamental problems of Southwestern history, and to formulate plans for coordinated attack upon them, to pool knowledge of facts and techniques, and to lay foundations for a unified system of nomenclature

The morning of Monday, August 29, was spent in inspecting the academy's excavations in the pre-Pecos site at Bandelier Bend, and in visiting the main Pecos ruin Monday afternoon and the mornings and afternoons of Tuesday and Wednesday were devoted to the business of the meeting, less formal campfire gatherings being held each evening On Thursday, September 1, several members of the group visited the excavations of the School of American Research at Puyé by invitation of Director E L. Hewett

In the preliminary discussions, special attention was paid to the classification of Southwestern culture-periods There was entire unanimity in regard to the general nature of Southwestern culture-growth, *i e.*, that its basic element, maize agriculture, was derived from the South, that from time to time certain other highly important elements such as cotton-growing, loam-weaving, and probably pottery-making, were also introduced from the same source, but that little more than the germ-ideas of these elements penetrated to the Southwest, and that the development of its culture was essentially autochthonous

There was practical unanimity as to the course of development, *i e*, that agriculture was taken up by a previously resident, long-headed, nomadic or semi-nomadic people, who did not practice skull-deformation, and who already made excellent coiled basketry, twined-woven bags, sandals, and used the atlatl; but whose dwellings were of perishable nature. The newly acquired art of agriculture led to a more settled life and to the development of more permanent houses. For some time, however, pottery-making was unknown. At a later date pottery was introduced, or possibly independently invented, houses of the pit type were perfected, and became grouped into villages, and the bow-and-arrow began to supplant the atlatl. The long-headed race, however, still persisted.

At a still later period there appeared certain important changes skull-deformation was initiated (the majority of those present at the conference believe that a new, broad-headed strain supplanted the ancient long-heads), dwellings emerged from the ground, the rooms became rectangular, and were grouped more closely, structural rings (corrugations) were for the first time left unobliterated on cooking vessels From then on the development of the culture was rapid After a period of wide extension, marked by small-village life, there was, perhaps a decrease in amount of territory occupied, and surely a concentration of population in certain areas, together with great architectural and ceramic achievement and strong regional specialization Subsequently large areas were abandoned, there appears to have been a considerable shrinkage of population, and there was a definite cultural degeneration. This period was brought to a close by the settlement of the Southwest by the Spanish about 1600

The meeting attempted, as a basis for more precise definition of culture-stages, to arrive at agreement as to diagnostic culture-traits A sub-committee prepared a chronological tabulation of elements, which was used during the subsequent discussions Architecture was considered to be of much value as an index of growth, as were village-types, sandals, pictographs, etc Much further information, both as to nature and distribution, was decided to be needed, however, before these categories can be used with full confidence Pottery, it was agreed, is at the present time the most abundant, convenient and reliable criterion, and the cooking wares the simplest type for preliminary chronological determinations Discussion brought out the following outline of development in this class of ceramics· first, plain wares, later, neck corrugations produced by leaving unobliterated the upper structural rings, still later, spiral corrugations ornamented by indentations and covering the entire vessel, again later, a degeneration of the corrugated technique, and, finally, disappearance of corrugations and return to plain-surface pots.

During all the discussions leading to development of the above outlines, there kept arising questions of period nomenclature Entire unanimity was not achieved, but the following terms for chronologically sequent periods proved acceptable to the majority

Basket Maker I, or Early Basket Maker—a postulated (and perhaps recently discovered) stage, pre-agricultural, yet adumbrating later developments

Basket Maker II, or Basket Maker—the agricultural, atlatl using, non-pottery making stage, as described in many publications

Late Basket Maker, Basket Maker III, or Post-Basket Maker—the pit- or slab-house-building, pottery-making stage (the three Basket Maker stages were characterized by a long headed population, which did not practice skull-deformation)

Pueblo I, or Proto-Pueblo—the first stage during which cranial deformation was practiced, vessel neck corrugation was introduced, and villages composed of rectangular living rooms of true masonry were developed (it was generally agreed that the term pre Pueblo, hitherto sometimes applied to this period, should be discontinued)

Pueblo II—the stage marked by widespread geographical extension of life in small villages, corrugation, often of elaborate technique, extended over the whole surface of cooking vessels.

Pueblo III, or Great Period—the stage of large communities, great development of the arts, and growth of intensive local specialization.

Pueblo IV, or Proto-Historic—the stage characterized by contraction of area occupied, by the gradual disappearance of corrugated wares, and, in general, by decline from the preceding cultural peak.

Pueblo V, or Historic—the period from 1600 A. D to the present.

As a by-product of the effort to define the various Pueblo periods, the following definition of a pueblo as an architectural type was arrived at A pueblo is an agglomeration of essentially rectangular living rooms of adobe or masonry construction, generally flat-roofed and built above ground

There was much discussion of the term "kiva" and of such parts of kivas as the ventilating passage, the fire-screen or deflector, etc It was agreed that ceremonial rooms varied so greatly in form and in interior arrangement, and that the types shaded into each other so imperceptibly that no valid distinction as to essential function could be drawn between, for instance, round and square, or between above-ground and subterranean examples. The following very broad definition was therefore adopted. A kiva is a chamber specially constructed for ceremonial purposes

It was hoped that the meeting could devote attention to the nomenclature of areas, of pottery types, pottery forms, elements of decoration, etc , but so many matters of greater immediate interest were brought up that these questions were deferred with the idea that they should be kept in mind by those present and gone into at a possible future gathering. It was, however, thought well to consider the advisability of a binomial ware-nomenclature; the first name to be indicative of the locality of highest development, the second a technically descriptive term, for example, Sikyatki yellow, Mimbres black-on-white, Upper Rio Grande incised, etc

There was no opportunity for consideration of the difficult and at present very confused question of names for design-elements, but Mr. K. M. Chapman,

of the New Mexico State Museum, Santa Fe, who has given this matter much study, offers to act as clearing-house for suggestions as to the nomenclature of design and to prepare a preliminary report as basis for further discussion

A survey was made of work now in progress or in contemplation, and areas under investigation were plotted on a map of the Southwest This brought out the fact that although certain central areas are under intensive study, the peripheral regions, with the exception of Nevada, are being neglected Information is badly needed as to the extent and nature of remains in southwestern Arizona, Sonora, Chihuahua, and eastern New Mexico Of the central districts, the Little Colorado in general and the Hopi country in particular deserve attention Chronologically considered, the field is being fairly well covered, but Basket Maker I and II, and Pueblo I and IV should be more strenuously attacked It was emphasized, however, that in spite of the need for much more work, it should become a practice to operate intensively rather than extensively, to make each excavation a model of care and thoroughness, and to leave undisturbed large parts of all important sites in order that they may be studied by the better-equipped students that the future is certain to produce It was brought out that our present methods for the preservation of skeletal material leave much to be desired.

Mr J L. Nusbaum, who has recently been appointed archeologist for the Department of the Interior, and been given supervision of the many ruins on the lands administered by that department, led a discussion of the issuance of permits, the handling of expeditions, the treatment of ruins during and after excavation, and the publication of results. Mr Frank Pinkley, of the National Park Service, who is in charge of Southwestern monuments, offered valuable suggestions as to the relation between field-workers and Park Service personnel He also advocated the placing of permanent markers on or near all sites excavated, to which surveys of work done should be tied, in order that excavated areas can in the future readily be located

Advantage was taken of the presence of Dr. Byron Cummings, who is, under recent state legislation, responsible for the issuance of permits for work in Arizona, to discuss the question of archeological investigations in that state This led to a general consideration of state laws, of the rights and duties of states and of outside institutions, and of unauthorized digging on public and private lands.

Dr. A. E. Douglass reported his researches on the climate of the southwest and gave the results of his study of tree-rings in their relation to the dating of pueblo and cliff-house ruins He appealed for the help of all field-workers in the gathering of further materials for this all-important investigation

A. V. Kidder

Carnegie Institution of Washington
and Phillips Academy

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FINANCIAL GRANTS TO ADVANCE RESEARCH[1]

From the income from the permanent endowment of the American Association a number of grants are made each year to further scientific research. On September 30, 1926, the endowment amounted to $140,876 66 (Treasurer's report of September 30, 1926), a large part of which ($42,350) was the accumulation of sustaining-membership and life-membership fees By constitutional provision, these fees are always invested and only the income therefrom may be expended

As more of the members realize the opportunities provided by life membership, the number of life members increases. The fee is now $100 By special action of the executive committee any person who has been a member but who has resigned or has allowed his membership to lapse may at the same time be reinstated and become a life member by paying his total arrearage in annual dues plus an amount sufficient to make a total payment of $100 The sustaining-membership fee is $1,000 Well-to-do persons who are interested in insuring the continuous advance of science should be sustaining members

Besides the sustaining-membership and life-membership fees, the permanent endowment includes the general endowment fund and the Jane M. Smith Fund The former amounts to $93,526 66, including the W Hudson Stephens bequest, the Richard T Colburn bequest and the Friends' Fund, an accumulation of smaller gifts. The Jane M Smith fund amounts to $5,000 By provision of the donor's will the income therefrom must be used each year for creating emeritus life memberships. There are now thirty-seven emeritus members and $2,850 of the life-membership fund has been received from the Jane M Smith fund Aside from the last-named fund, which yields interest at 6 per cent, the association has recently received about 4.64 per cent. on the invested funds. For the fiscal year 1925–26 (from October 1, 1925, to September 30, 1926) the incomes from the general endowment and from the sustaining-

[1] See also Science for October 7, 1927

membership and life-membership funds amounted to $4,337.71, $278.23, and $1,686.01, respectively, totaling $6,301.95.

The recent policy of the association has been to maintain in the treasury a small fund available for appropriation in emergency and to appropriate the rest of the available funds each year. Appropriations from the treasurer's available funds are now made in four ways. First, there is a small annual appropriation for treasury expenses, recently $20 for safety-deposit drawer. Second, an appropriation of three dollars per year is regularly made to care for the journal subscriptions of living life members and living sustaining members. For 1926 these amounted to $1,227. Third, grants are made directly by the council or its executive committee from time to time, to organizations or institutions. In this class belong the recent grants to the Naples Zoological Station, to the Barro Colorado Laboratory and to the Concilium Bibliographicum. Fourth, small individual grants in aid of research, amounting to about $3,000 a year, are allotted from an appropriation for that purpose, by the Committee on Grants for Research.

Individual grants are generally for not more than $500, in many cases for much smaller amounts. The annual allotment of these grants occurs in December of each year. Applications may be sent to the Washington office at any time, on application blanks that are supplied by the permanent secretary. For consideration at any allotment, applications must be in hand by December 1. Applicants are notified in January, with regard to the action on their applications, and the grants authorized become immediately available.

A summary of all grants made by the association in past years has recently been prepared in the permanent secretary's office. For information and as a matter of record, résumés of this summary are presented below.

Annual Totals of Individual Grants

Year	Total Amount	Year	Total Amount	Year	Total Amount
1888	$ 300	1902	260	1916	100
1889	200	1903	300	1917	2,350
1890	400	1904	50	1918	2,900
1891	250	1905	360	1919	3,300
1892	150	1906	150	1920	4,000
1893	200	1908	400	1921	5,000
1895	325	1909	100	1922	3,750
1896	200	1910	60	1923	3,175
1897	100	1911	225	1924	3,425
1899	50	1912	75	1925	2,900
1900	150	1913	100	1926	2,750
1901	283	1915	150	1927	2,050
				Total	$40,538

Grants to Institutions, etc.

Year	Amount
1892	$ 100, Naples Zoological Station.
1895	100, Biological Laboratory, Cold Spring Harbor
	100, Biological Laboratory, Woods Hole
1896	750, Science
1897	100, Biological Laboratory, Woods Hole.
	250, International Bureau of Bibliography
1898	100, Biological Laboratory, Woods Hole
1904	100, Concilium Bibliographicum
1906	200, Concilium Bibliographicum
1907	100, Concilium Bibliographicum
1908	100, Concilium Bibliographicum.
1909	100, Concilium Bibliographicum
1910	50, Concilium Bibliographicum
1911	75, Concilium Bibliographicum
1912	100, Concilium Bibliographicum
1913	200, Concilium Bibliographicum
1915	400, Concilium Bibliographicum
1916	250, Concilium Bibliographicum
1919	500, Botanical Abstracts.
	200, Journal of Physical Anthropology.
1920	500, Botanical Abstracts
1922	250, Botanical Abstracts
	500, Naples Zoological Table
1925	200, International Annual Tables.
1926	500, Naples Zoological Table
	200, International Annual Tables.
	25, Ecological Society of America.
1927	300, Barro Colorado Laboratory
	500, Naples Zoological Station
	200, International Annual Tables
	200, Concilium Bibliographicum.
Total	$7,250

In addition to the above-named grants from treasury funds the following grants have been made from the general funds of the association:

1923	$200, International Annual Tables.
	100, American Institute of Sacred Literature.
1924	200, International Annual Tables.
	60, American Institute of Sacred Literature
1925	100, National Conference on Outdoor Recreation.
1926	100, National Conference on Outdoor Recreation
	60, American Institute of Sacred Literature.
1927	55, American Institute of Sacred Literature.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENCE

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RELATIONS OF THE AMERICAN ASSOCIATION TO THE NATIONAL ACADEMY[1]

THE advancement of science, for which both the National Academy and the American Association stands, has, in the last century, come to represent a great profession of many branches The number of professional scientists has increased very remarkably in the last half-century in our country, and it continues to increase at an accelerated rate Science is becoming recognized as one of the important professions A young man may now look forward with assurance to a professional career in science

The new science profession embraces both research and teaching, the securing of new knowledge and the distribution of knowledge that has already been secured The two are obviously closely allied, but they represent different aspects of the advancement of science, both of which are necessary Scientific research includes investigations of both the "pure" and the "applied" kinds and these also represent different aspects of the same general endeavor, although they are not readily separated when one attempts a categorical classification And science teaching embraces many kinds of work, from elementary instruction to the guidance of candidates for the doctor's degree of a university, from special consultation to the giving of public lectures, from the writing of popular stories on science subjects to the preparation and editing of technical contributions in the several special branches

Coordinate with the development of this complex professional field has developed an increasing need for the organization of scientists, which has been met by the formation of many special societies, each aiming to hasten the advance of science along a particular line or group of related lines These are devoted to the advancement of the sciences rather than to the advancement of science Their journals and their meetings are of and for specialists

Before the advent of these societies mathematics and the natural sciences had their general organizations in the National Academy, the American Association, the American Philosophical Society, the American Academy and a number of state academies. Their meetings tended to bring together specialists

[1] Address given at the dinner of the National Academy of Sciences, at Urbana, Ill., October 19, 1927

in widely different fields and their publications aimed to present scientific advance in the several branches of research without too much classification into specialized groups In their later development these organizations have maintained themselves and some of them have retained great prestige and importance, but the growth of so many special societies, with their journals and their meetings and their dues, has undoubtedly detracted from the generalizing influence of the broader organizations

In recent decades it has been realized and remarked by many minds that the unquestionably great gain to science that has resulted from the formation and activities of the special societies has not been secured without considerable and serious losses in the realm of scientific synthesis, in the broad appreciation of knowledge as a whole I touch here on the frequently discussed problem of over-specialization in individual intellectual workers, which is reflected in our organizations Modern specialization in science tends to promote remarkable ignorance and even intolerance in regard to fields not closely related to the one specialized in I am reminded of a brilliant schoolmate of mine who did not care even to dip into the writings of Thomas Carlyle because he had not yet read all of what Charles Darwin had written I am also reminded of a pungent remark once made to me by a Russian agricultural scientist trained under the imperial régime "The staff members of your American bureaus and stations for agricultural research," he said, "are mainly uneducated experts" It has been very aptly said that "a specialist is a man who knows more and more about less and less"

Under the analytical influence, the American Association became subdivided into sections similar to those of the National Academy Under the synthetic influence, as the special societies came forward, an arrangement was perfected by which, as affiliated organizations, they take part officially in directing the affairs of the association

A further movement toward the interchange of ideas between different groups of specialists was inaugurated just before and during the Great War Through cooperation of the National Academy and the American Association were organized the beginnings of the National Research Council, which has subsequently developed so satisfactorily and fruitfully under the leadership and sponsorship of this academy

The association tries to further the interchange of ideas among scientists working on apparently divergent lines and it enjoys the cordial cooperation of the National Research Council Wherever it has been in a position to do so the association has been glad to aid in work undertaken by the council. I must add, however, that my Washington office has, I fear, thus far received more help from Dr Kellogg's office than his has received from mine. It is a pleasure to acknowledge at this time many valuable aids that have been had by the association from the Research Council

Toward a further broadening of scientific specialization, if you will permit me to employ such an expression, we may work, I think, in about six general ways (1) by bringing together scientists from different fields of science, as in committees of various kinds that may inaugurate and direct large movements and cooperative research projects, (2) by arranging and maintaining general-science publications for scientists, (3) by arranging scientific meetings for all kinds of scientists and others interested in science, (4) by encouraging an *esprit du corps* among scientific workers in general, (5) by undertaking to secure such modifications of the methods of school and college education and university training as may be promising and feasible, and (6) by aiding and encouraging the publication of popular but truthful accounts of scientific knowledge All these lines of work are represented in projects that are engaging the attention of the National Academy and the association The first is exemplified in the scientific divisions of the Research Council and in the sections of the association, in their efforts to maintain a sort of perpetual exchange among the different special societies and among different groups of research workers as well as among the individuals of each group.

An excellent example of a general-science publication calculated to encourage individual cooperation and to promote broader appreciation, is the American Association's official journal, SCIENCE. Throughout a third of a century, under the far-seeing and efficient guidance of Dr Cattell, SCIENCE has added its increment of broadening influence week by week It has played an important part in gaining and maintaining the membership of the association and one of the most tangible of the association's accomplishments is the arrangement by which this journal has so long been its official organ As you all know, the present owner has generously made an agreement with the association by which the journal will eventually become the property of the organization You are familiar with the *Proceedings* of the National Academy, which aims to secure wide circulation of original announcements of the results of American research among investigators in all branches of science. The publications of the National Research Council are also to be mentioned here with great appreciation.

The scientific meetings of the academy bring to-

gether many kinds of scientific workers and have always tended toward the end we are here considering. In a broader way the annual meetings of the association contribute in the same direction By combining its meetings with those of many of the special societies the American Association has brought together probably the largest gatherings of all kinds of scientists that have ever occurred The salutary influence of these conventions, where workers in widely different fields have opportunity to become mutually acquainted, can not, I think, be overestimated

With their continued increase in size and complexity the annual meetings of the American Association are becoming a serious financial problem Locally raised funds are generally very inadequate and dues and registration fees are purposely kept as low as possible The association very much needs a substantial endowment for the holding of the annual meetings, which are surely almost a national necessity now and which can not be expected to be self-supporting I should like here to make a personal suggestion that the National Academy might perhaps be interested to aid in finding means by which the effectiveness of these annual conventions may not be curtailed through too great economy

Through the democratic nature of its organization and through the publication of its official journal the American Association cultivates the feeling among all of us scientific workers that we all belong together, no matter how wide may be the apparent separation of the scientific details with which we deal individually We are now a happy family of nearly 15,000 members In this part of our endeavor to bring science home to the scientists the National Research Council is also actively engaged

The very fundamental project of improving the education of those who are soon to be the future scientists and appreciators of science is of course primarily the concern of the Education Section of the association. With that section are affiliated several societies, including the National Education Association. Other sections deal with the same project A special committee of the American Association as a whole, on the place of science in education, is making a special study of present trends in this very important branch of scientific work, for the science of the future will depend on the education of the present. The National Research Council has also taken a prominent part in this line of work

The general education of the public at large, in scientific matters, and the cultivation of public appreciation of what professional workers in science are trying to accomplish are being carried on especially by Science Service, for the guidance of which the National Academy, the National Research Council and the American Association are jointly responsible. An important feature of recent annual meetings of the association is a well organized news service, which aids the representatives of the press and other non-technical writers to secure information about the papers presented at the meeting and to make personal contacts with the scientists

I have tried to bring before you some of the main ways in which an important present trend of the best scientific thought is being jointly supported by the National Academy and the American Association. The two organizations cooperate in many other ways and we hope that new ways may be developed from time to time The select nature of the academy and its consequent reliability and prestige make it logically the upper house in the parliament of American science workers, as Cattell has remarked, while the democracy of the association and the fact that most young scientists, as well as those of riper experience, are enrolled as members and are actively interested in its work, make it logically the lower house

Burton E Livingston

THE ACTIVITY OF NERVE[1]

Until the nineteenth century practically all hypotheses as to the nature of conduction assigned to the nerve fiber a passive rôle Energy or substance entered at one end and was carried to the other, where it produced its effect In the middle of the eighteen hundreds the production of an electric change by nerve during activity was discovered, and later were found, first, the existence of a refractory phase for a few thousandths of a second after an impulse had passed during which a nerve could not transmit a second impulse, and, second, the independence of the intensity of the effect produced from the intensity of stimulus applied These facts indicated the active participation of the nerve fiber in carrying the impulse In the early years of this century it was further found that a nerve slowly lost its conductivity under conditions of asphyxia and recovered with oxygen, suggesting an oxidative basis for this activity Attempts to follow the respiration of nerve were partly successful, but careful experiments failed to demonstrate the production of heat (which must accompany oxidations) during nervous activity, so the interpretation of chemical findings was rendered very uncertain.

The series of researches to be described,[2] carried out in the laboratories of Professors Hill and Meyerhof,

[1] Summary of a lecture delivered at the Biochemical Laboratory, Cambridge University, August 2, 1927

[2] See R. W. Gerard, *Am Jour Physiol.*, LXXXII, 381, 1927, for further details and literature.

began with a redetermination of the heat production of nerve Isolated frog sciatics were arranged for stimulation at the upper end, the lower halves resting on a thermopile so wound as to bring several hundred insulated constantan-silver junctions against the nerve Although the thermopile sensitivity under these conditions was about 2,000 microvolts per calorie liberated, tetanization of the nerves for ten seconds at 280 shocks per second gave only about one tenth of a microvolt Through the thermopile and galvanometer resistances currents of about 10^{-10} amp would result, which are much too small for even high sensitivity galvanometers A successful means of amplification was found, the thermopile current passed through a sensitive moving coil galvanometer, the mirror of which reflected a strong vertical beam of light At rest this fell half way across the slit of a radiation thermopile, setting up a constant potential and current through a second sensitive moving magnet galvanometer connected with it Movements of the first instrument of a small fraction of a millimeter allowed more or less of the reflected light and heat to reach the thermopile and, by varying the potential this produced, gave large deflections of the second galvanometer The sensitivity of the whole system was 2×10^{-12} amp = 1 mm deflection at 1 meter, and tetanizing the nerves gave deflections of about 200 mms For purposes of calibration a known amount of heat could be produced in the nerves by passing an alternating current, too weak to stimulate, through their length.

It was soon found that the deflection during tetanization at 280 shocks per second at 15° C corresponded to a liberation of $7\,6 \times 10^{-6}$ cal per grm per sec. The deflection, however, fell very slowly, requiring ten minutes after stimulation was stopped to return to zero, whereas a current heat deflection was over in less than a minute It was obvious, therefore, that nerves continued to produce heat for about ten minutes after they had been active, and comparing the areas of the curves for nerve heat and current heat showed that the total heat produced per gm and sec stimulation was $6\,9 \times 10^{-5}$ cal The resting heat production had to be determined indirectly from the change in base line when a nerve was asphyxiated, and was found to be 2×10^{-5} cal per gm and sec, to which the above values are an addition

Analysis of the galvanometer curves obtained by stimulation yielded information as to the amount of heat produced second by second and showed that nerve, like muscle, produces its heat in two distinct phases For each impulse there is an outburst of heat lasting a few thousandths of a second which is followed by a feeble but prolonged heat liberation. Although the rate of heat liberation in the initial phase is 5,000 times as great as at the start of the delayed, only 11 per cent. of the heat is produced during the first phase, the remainder appearing in the delayed one, most at first and slowly fading out

The values given so far were determined by tetanization at 280 shocks a second To obtain the absolute heat production for a single impulse, stimulation was carried out at different frequencies and the heat production of the nerve measured The heat per second does not rise as fast as the frequency, so that the heat per impulse falls as successive impulses follow one another more and more closely The fall is already apparent when impulses are as much as 030 sec apart, so that the effect of one impulse lasts longer than this time Presumably when an impulse traverses a nerve some energy-giving reaction takes place, and the reactive substance is then rapidly reformed If all that is present at any time is discharged by an impulse, the return of heat-producing power gives a measure of the course of reformation Also since reformation is very probably itself accompanied by wastage of energy and heat formation, the initial phase of heat may well be made up of two subsidiary phases, one accompanying conduction itself and the second accompanying the immediate restitution of the system Aside from these considerations, the frequency experiments showed that at 280 per second each impulse gives only one fourth as much heat as an isolated one, so that the initial heat per impulse per gm of nerve is 10^{-7} cal, and the total heat almost exactly one millionth of a calorie For a single impulse traversing 1 cm length of a single fiber the values are one millionth of these

Further insight into the underlying chemical processes was gained by studying the effect of oxygen-lack on heat production and later by direct chemical studies In the well explored case of muscle, it has been found that the initial phase of heat production accompanying contraction is independent of oxygen and is associated with the formation of lactic acid from glycogen, whereas the delayed phase occurs only when oxygen is available and is associated with oxidation of about one fourth of the lactic acid and reconversion of the remainder into glycogen In absence of oxygen, a muscle is able to continue activity for a long time, securing its energy from the formation of lactic acid which then simply accumulates The picture of nerve activity is essentially different, for in absence of oxygen both initial and delayed heats fall gradually to practical extinction in about three hours (at which time the nerve is asphyxiated and also loses its power of conduction) but the ratio remains the same throughout The fall in heat is probably due largely to a gradual failure of one fiber after another, though the heat in each fiber is also probably less,

due to conduction of subnormal impulses These results are better interpreted with the aid of data on respiration

Isolated sciatics were placed in small glass chambers with electrodes fused through the walls and fitting by ground glass joints to one or both limbs of a manometer With alkali present in the chamber to absorb CO_2 any volume decrease represented oxygen consumed, and with opposite nerves in chambers on the right and left limbs of a manometer the resting oxygen consumption balanced out and the effects of stimulation of one side were obtained directly, with an error of only a few per cent With no alkali present, the CO_2 produced could also be estimated Experiments carried out under the same conditions as those on heat production showed the resting oxygen consumption to be 16 cmm per gm and hour, and the increase on stimulation (when tetanized with 280 shocks a second for twenty-two seconds every four minutes) 61 cm per gm and hour stimulation The oxygen needed to produce the previously measured heats, if these were entirely due to oxidation of ordinary foodstuffs, is 14 cmm for the resting and an extra 48 cmm for the active states, so that there is little question that all the energy of the resting as well as the active metabolism is obtained by oxidations Further, the extra oxygen consumption does not appear or cease sharply with the start and stop of stimulation, but shows a lag of about a quarter of an hour before reaching its maximum at start or its zero at stop, indicating that much, if not all, the oxygen consumption is delayed in time, corresponding to the delayed heat

The R Q during rest is 0 77 (between 0 75 and 0 80), corresponding to the burning of a mixture of fats, proteins and carbohydrates The R Q of the extra metabolism of activity is 0 97 (between 95 and 1 0), corresponding to the burning of carbohydrates, though the R Q of protein would also be 0 95 if the nitrogen ended in the form of ammonia rather than urea As a matter of fact, about 0 45 mgm per cent of extra ammonia is formed during an hour of continued activity which, if all freed by protein oxidation, would mean enough protein oxidized to account for the oxygen consumed It is improbable that the ammonia comes from this source, for at rest 0 2 to 0 3 mgms per cent of ammonia per hour is also formed, and equally whether the nerve is in oxygen or nitrogen, but pending further evidence it is not safe to conclude that carbohydrate is the sole fuel used by nerve for its activity

Another significant fact appears when stimulation is continued without interruption rather than for short periods with rests between The extra oxygen consumed then is only 18 cmm per gm and hour of stimulation, though this value may be maintained for several hours The heat production per stimulus is also decreased when stimulation is repeated at short intervals It appears, therefore, that the amount of energy a nerve can liberate per unit time of activity depends upon what fraction of the total time is spent in activity and what in rest For short periods of activity it is able to discharge more energy than for longer ones This can hardly be a "fatigue," in the sense of progressive failure due to activity, since the characteristic level of energy liberation is reached within a few minutes after any particular type of stimulation is begun and then remains constant for hours It is suggested, therefore, that this coming to some equilibrium value be called "equilibration"

The evidence so far presented shows that during activity (as well as rest) a nerve obtains all its energy ultimately from oxidations Little, or none, of the oxidations accompanies the nerve impulse itself, but rather they follow in the next 10–15 minutes, so at least two processes, probably three, occur in sequence. These can not be segregated or separated in time by oxygen lack, but after the impulse has been conducted the whole series of changes must run to completion in the usual manner By analogy with muscle the thought occurs that the first stage is the formation of lactic acid and the last is its oxidation (The ratio of initial to delayed heat is 1 9 instead of 1 1 5 as in muscle, which would correspond to the production of lactic acid followed by its total oxidation rather than partial restitution to glycogen) If this were so, and the second stage must follow the first, no lactic acid should accumulate as a result of activity even in the absence of oxygen

Sciatic nerves resting in nitrogen produce lactic acid, as do most other tissues The production starts slowly and reaches a maximum rate of about 7 mgm per cent per hour in two to three hours after a nerve is put in nitrogen, then gradually falls to zero If glucose (but not levulose or galactose) is added to the solution containing the nerves lactic acid formation continues at the maximum rate for days or until all the added glucose has been used up Without added glucose about 100 mgm per cent lactic acid is formed in all, in 30 hours at 15° C, in seven to eight hours at 28° C, and there is in fresh nerve just about this quantity of carbohydrate These facts leave little doubt that nerve will form lactic acid when kept in nitrogen as long as any precursor is available, and that the main precursor is glucose These figures are similar to those for muscle, as is also the resting oxygen consumption, and indicate no great dissimilarity between the resting processes in the two tissues.

On stimulation in nitrogen, however, the story with nerve is entirely different, for, as anticipated from

the previous evidence, there is no increased accumulation of lactic acid If more is formed it is also oxidized and, indeed, there is no direct evidence that lactic acid appears even as an intermediary step in the breakdown of sugar accompanying nerve conduction

The picture now arrived at is, of course, very sketchy, but two questions require attention before even the broad outlines are complete First, if the processes of conduction ultimately depend on oxidations, why can a nerve continue activity for several hours in nitrogen? Second, since most if not all the oxidations and energy changes occur after the impulse has been conducted, how do they enter into the system and why are they so essential? The answer to the first seems fairly definite Nerve contains substances which are in an oxidized state when oxygen is present but can be reduced in its absence and so permit oxidations in the tissue—*i e*, an oxygen, or better oxidizing, reserve Glutathione, cytochrome and similar respiratory intermediates might play such a rôle and, with some assumptions, it may be calculated that glutathione in nerve might alone permit oxidations for an hour's activity Experimentally it is found that when a nerve is exposed to oxygen after two hours in nitrogen it takes up during the first hour in oxygen considerably more of this gas than later on, in fact, the extra oxygen taken up is about two thirds as much as it would normally have used during the time in nitrogen Still more direct evidence is found in the fact that, kept over night in nitrogen, a nerve actually *produces* 10–15 per cent as much CO_2 as it would in the same time in oxygen, and presumably most of this appears in the first few hours Finally, nerve as other tissues does not produce lactic acid during rest as long as oxidations are in progress and, as stated, the lactic acid production does not get under way for about two hours after a nerve is put in nitrogen All these facts suggest that, due to a reserve, oxidations may continue several hours after external oxygen is excluded—and during this time a nerve continues in fact to be able to conduct

The second point has not yet been answered, but some evidence is available The simplest assumption for the first reaction, accompanying conduction, is that some substance, presumably carbohydrate, is changed to another, $C \xrightarrow{O_2?} X$, and in the second delayed stage $X + O_2 \rightarrow CO_2$ This can not, however, be correct, for after a few hours in nitrogen there is still plenty of C left and accumulation of X is apparently unable to inhibit the first reaction, at least if X is diffusable, for a nerve kept in gas fails no sooner than one in fluid This would mean that cutting out the second reaction could have no influence on the future carrying out of the first. Such an influence would be present, however, if an accessory substance A, necessary for the first reaction, were changed to an inactive state A^1 in the first stage and returned to its original form by the second (The change might conceivably be a physical rather than a chemical one.)

$$C + A \xrightarrow{O_2?} X + A^1 \quad \ldots \quad 1$$
$$X + A^1 \rightarrow CO_2 + A \quad \ldots \quad 2$$

This scheme is still too simple, as it ignores the changes immediately following the conduction of an impulse, while a nerve passes from the absolutely refractory period to normal conductivity and energy liberating capacity This intermediate change implies a third reaction, and very probably it is this one that fails as a result of the absence of the delayed changes The skeleton of the complete system[3] would then be

$$C + A \xrightarrow{O_2?} X + A^1 \quad 1$$
$$A^1 + E \xrightarrow{O_2?} A \quad \ldots\ldots 2$$
$$X + O_2 \rightarrow CO_2 + E \quad . \ 3$$

in which the extra factor E is needed to restore A^1 to A and is produced only during the final reaction

With a limited quantity of the A, A^1 system and a variable excess of E, this hypothesis accounts for the facts given above, as well as many others During conduction all A present changes to A^1, if less than the normal amount be present the impulses are of subnormal intensity and produce less heat, if less than a critical value conduction is entirely suspended. During the refractory period, reaction 2 restores A, the absolutely refractory period lasts until the critical amount of A is restored, the relatively refractory one until restoration is complete Reaction 3 is relatively extremely slow, lasting 10 minutes, so that with activity the amount of E falls until an equilibrium is reached between its formation and use For repeated activity of a few seconds with minutes of rest between, the resting concentration of E will be practically maintained and reaction 2 and so 1 proceed as after rest But as the activity is prolonged and rests shortened the restoration of E will lag further and further behind, reaction 2 will be progressively slowed and subnormal or less frequent impulses will result. This corresponds to the process of equilibration shown by heat production and oxygen consumption (and

[3] This may also be expressed, to indicate better the nature of reactions 2 and 3 as a means of "winding up" the mechanism for reaction 1, as follows:

$$CA \rightarrow A^1 + X \quad \ldots \quad 1$$
$$C + A^1 + E \rightarrow CA \quad \ldots\ldots \quad 2$$
$$X + O_2 \rightarrow CO_2 + E \quad \ldots\ldots \quad 3$$

action current as well). It has been found by Field and Brucke, which accords with this hypothesis, that the refractory period steadily increases with continued stimulation for at least 10 minutes and recovers during rest. After equilibrium is established, in several minutes, no further change takes place as long as the same stimulation is continued, until in many hours fatigue, possibly due to exhaustion of C, sets in

Absence of oxygen interferes with reaction 3 In nitrogen the oxidizing reserve permits it to continue for some time, but more and more slowly as the reserve is used up, and finally it ceases entirely The amount of E will *correspondingly* slowly *fall* and, exactly as above, reaction 2 and then 1 be interfered with and weaker and less frequent impulses be conducted, the system eventually tending, however, not to equilibrium but to completion with failure of conduction The fall in heat, prolongation of refractory period reported by Frohlich and by Kato, spreading out of action current, etc, that accompany the course of asphyxia all find their explanation on this basis

Other phenomena of nervous activity are in conformity with this scheme, but it is not wise to press it further till more definite knowledge of the actual changes postulated is available At present there is evidence that other changes than the direct energy yielding ones are indeed present, but what rôle they play, if any, remains to be determined The formation of ammonia has been mentioned and there are also changes in phosphates (unpublished observations) In fresh nerve there is about 60 mgm per cent of "soluble" phosphate (expressed as P_2O_5), of which less than half is free inorganic and the remainder partly in an acid labile combination (phosphagen?) partly in an acid stabile one (lactacidogen?) Long standing in oxygen has little effect on the distribution, but standing in nitrogen sends all or nearly all of the phosphate into the inorganic form

It remains to correlate this material with some actual mechanism of conduction The current view that activity of one portion of a nerve fiber is the stimulus to the adjacent portion and so along the entire fiber has much to support it, especially in the form developed by Lillie Recent evidence indicates that conduction itself may be analyzed into two phases occurring repeatedly in succession The first is an explosive type of chemical change in a portion of the membrane surrounding the nerve fiber, and it leads, probably by local potentials, to ion movements within the fiber, which constitute the second phase Local concentration of ions against an adjacent portion of membrane initiates here the explosive change, and so on Probably the ion movements are associated with only a small fraction of the energy changes, and all the material presented above concerns itself mainly with the behavior of the membrane during and after conduction Reaction 1 would thus be the one directly entering into conduction, the explosive change determining by its intensity the amount of potential developed, the distance ahead that adequate ion movements take place, and so the intensity and speed of the nervous impulse Most factors affecting conduction act primarily through the membrane reactions, but some, as for example diameter of the nerve fiber, may act through the ion changes It seems not impossible to account for the phenomena associated with the activity of nerve along the lines here sketched, and, *recalling that the metabolism of central nervous* tissue is several hundred times as intense as that of peripheral nerve, there appear to be available many new data to help account for such reflex phenomena as summation and fatigue

R W GERARD

UNIVERSITY OF CHICAGO

HAWAII'S TRIBUTE TO DR. NEWCOMBE

DR FREDERICK CHARLES NEWCOMBE, professor emeritus of botany and retired head of the department of botany at the University of Michigan, died in Honolulu, T H, October 1, 1927, aged sixty-nine years

On account of failing health, Dr and Mrs. Newcombe had made their home in Honolulu since October, 1923, soon after Dr Newcombe's retirement from the university Mrs Newcombe died July 10, 1927.

Although never of robust physique, Dr Newcombe was an indefatigable worker Even after coming to Hawaii, he continued his researches on the sensitive reactions of plants at the Hawaiian Sugar Planters' Association with which he was associated.

The rare opportunity was afforded Dr. Newcombe, after retirement from a long, active career of teacher, research worker, executive of his department, editor and counselor to many, to carry his endeavors into a new and different environment Here he not only continued research in his chosen field, but became a leader in the scientific thought and life of the territory Few indeed, even if they had not been burdened as he was by failing health and the strain of the long, fatal illness of a loved one, could have grasped such an opportunity. It is a tribute to the man's undying loyalty to the work he loved, to his keen mind, tactful optimistic personality, indomitable will power and sound judgment, which never permitted him to do anything hastily, that he was able, in spite of anxiety, physical and mental suffering, to gather together and unify into two working organizations the many diverse scientific interests of the

territory. Where others had failed Dr. Newcombe succeeded. In a quiet unassuming manner, he led in the gathering together of a small group of botanists and the organization of the Hawaiian Botanical Society, April 7, 1924. He became the first president of the new organization and by the end of his presidential year its success was assured. Its growth and development have been steady.

In the same manner, through his influence, a larger group with more diversified scientific interests gathered at the University of Hawaii and there under his leadership the Hawaiian Academy of Science was organized July 23, 1925 Again he served in the capacity of first president during the first critical year of its existence, giving freely of his time, energy and the wisdom of his deep rich life. The successful year closed with a four-day session devoted to the reading of papers bearing on various scientific subjects of interest. The Hawaiian Academy of Science has continued its active growth

Dr Newcombe's helpfulness to the cause he loved did not end with the organization of these two societies. The latchstring of his study was always out Never was he too busy, too tired or too engrossed with his own affairs to pause and help with advice, suggestion or criticism a fellow worker. In fact it seemed as if he could not do or give freely enough from his rich life Age, sickness and sorrow did not dim the brightness of his great mind. He remained, as he would have wished, in full possession of his mental faculties until a few hours before his death As he approached the sunset of his life, those who knew him best felt a softening and a mellowing of his natural austereness Many an eye was moist at the close of the simple service held in his home, where alumni of the University of Michigan, friends and scientists had gathered in the hush and quiet of the late Sabbath afternoon, to pay tribute by word and profusion of flowers to the memory of a great teacher, scientist and friend His passing means much to the community at large, to the scientific world and to his friends here and on the mainland.

As student and author of many articles on original research, as teacher, counselor and inspiration to his students and fellow workers, Dr Newcombe has exercised a dominating influence in the advancement of scientific thought in America

Elizabeth Dorothy Wuist Brown
Bernice P Bishop Museum,
Honolulu

SCIENTIFIC EVENTS

THE AUSTRALIAN NATIONAL RESEARCH COUNCIL

The annual general meeting of the Australian National Research Council was held in Melbourne on August 25 and 26. According to a report printed in *Nature*, particular attention was given to the financial position of the council in relation to present and future work. The offer of the Carnegie Corporation to provide a sum of £5,000 as the nucleus of a research fund was accepted with most cordial thanks, and with this sum and more than £1,000 available from other sources, such a fund was formally instituted A strong committee was appointed to take action for securing additional contributions from Australian sources, and it is hoped that before long the council will be in a position to give considerable aid to Australian workers in pure science. Amongst several satisfactory reports on the year's work was one from the anthropology committee outlining the progress made since the initiation of the department of anthropology in the University of Sydney This step followed upon a resolution by the second Pan-Pacific Science Congress of 1923 and was made possible by contributions from the commonwealth and state governments and the Rockefeller Foundation The new department is now in full swing and is taking active steps to organize investigations both on the mainland and on the neighboring Pacific islands. The following new members were elected to the Australian National Research Council, the total membership of which may not at any time exceed 100 Mr C R P Andrews (director of education, Western Australia), Professor A R Radcliffe Brown (anthropology, University of Sydney), Professor A N S H Burkitt (anatomy, Sydney), Professor A J Ewart (botany, Melbourne), Dr W A Hargreaves (government chemist, South Australia), Professor J W Paterson (agriculture, Perth), and Dr. H R. Seddon (Veterinary Research Station, New South Wales)

The trustees of the Commonwealth Science and Industry Endowment Fund in Australia are this year making £1,250 available in small grants for the assistance of scientific workers in Australia. The lines which will be followed in making the grants will be similar to those which have been proved to be satisfactory by the Department of Scientific and Industrial Research in Great Britain. The Commonwealth Fund has an invested capital of £100,000, and it is provided by act of parliament that the interest from it shall be employed for the dual purposes of training students in the methods of scientific research and in providing assistance to persons engaged in research, irrespective of whether their work has an obvious practical application or not At present, the income is being devoted mainly to the first object, but as time goes on it is expected that an increasing sum will be available annually for distribution in grants.

LECTURES BY INDUSTRIAL FELLOWS AT THE MELLON INSTITUTE

The following course of lectures on technologic subjects, by specialists engaged in scientific investigation

in the Mellon Institute of Industrial Research of the University of Pittsburgh, are being given at 11 30 A. M to 12·30 P. M (4th period), in the fellows' room of the institute All the discourses will be open to interested faculty members and qualified students of the university, to teachers of chemistry and chemists of the Pittsburgh district and to the membership of the institute

1 Petroleum Refinery Technology, W A. GRUSE

October 3	*Petroleum distillation practice*
October 10	*Chemical treatment of petroleum distillates*
October 17	*Properties and uses of petroleum products*

2 By product Coke Technology, O O MALLEIS

October 31	*By product coke oven practice*
November 7	*Recovery of by products from coke oven gas*

3 Technology of Ceramic Products, S M PHELPS, TRACY BARTHOLOMEW, E S ROSS, B A. RICE and E J CASSELMAN

November 14	*Raw materials and manufacture of refractories* (Mr Phelps)
November 21	*Properties, uses and testing of refractories* (Mr Phelps)
December 5	*Raw Materials and manufacture of Portland cement* (Mr Bartholomew)
December 12	*Properties, uses and testing of Portland cement* (Mr Bartholomew)
January 9	*Asbestos and magnesia products* (Mr Ross)
January 16	*Vitreous enamels* (Mr Rice)
January 23	*Window glass* (Mr Casselman)

4 Manufacture of Explosives, H L Cox

February 13	*Agricultural and mining explosives*
February 20.	*Special military explosives*
February 27.	*Detonators*

5 Paper Industry, MARC DARRIN

March 5.	*Manufacture of paper pulp*
March 12	*Manufacture, properties and uses of paper products*

6 Leather Technology, M C WALSH

March 19	*Histology of skin and chemistry of tanning*
March 26	*Vegetable tannage*
April 2	*Mineral and other tannage*

7. Cereal Products, R. E IRVIN

April 16	*Chemistry of cereals*
April 23.	*Milling of cereals*
April 30.	*Baking technology*

8 Fine-chemical Industry, L. H CRETCHER

May 7.	*Disinfectants and antiseptics*
May 14.	*Anesthetics and hypnotics*
May 21.	*Biochemical manufacturing processes*

STANDARDS FOR SCIENTIFIC AND ENGINEERING SYMBOLS AND ABBREVIATIONS

THE decision to undertake the standardization of scientific and engineering symbols and abbreviations as a national enterprise was made at a general conference called by the American engineering standards committee and held in the rooms of the American Society of Mechanical Engineers on February 13, 1923 Three organizations, the American Institute of Electrical Engineers, the Association of Edison Illuminating Companies and the American Society of Mechanical Engineers, made the original recommendations which resulted in the calling of this conference Official representatives of national organizations attended this conference and after a full discussion they voted unanimously that this project should be undertaken, and that the American Association for the Advancement of Science, the National Research Council, the Society for Promotion of Engineering Education and the U S Bureau of Standards should be requested to accept joint sponsorship Later the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Society of Civil Engineers were invited to become joint sponsors.

The sectional committee on scientific and engineering symbols and abbreviations now consists of thirty members representing thirty-seven national organizations. It has organized nine subcommittees to which have been assigned the following divisions of the subject (1) symbols for mechanics, structural engineering and testing materials, (2) symbols for hydraulics, (3) symbols for heat and thermodynamics, (4) symbols for photometry and illumination, (5) aeronautical symbols, (6) mathematical symbols, (7) electrotechnical symbols including radio, (8) navigational and topographical symbols, (9) abbreviations for scientific and engineering terms The reports of these subcommittees will be prepared and issued separately.

The proposed standard on symbols for heat and thermodynamics was prepared by subcommittee No 3, of which Dr Sanford A Moss, Thomson Research Laboratory, General Electric Company, is chairman This subcommittee was organized on April 5, 1926, by direction of the executive committee of the sectional committee on scientific and engineering symbols and abbreviations for the purpose of recommending a list of standard symbols for use in the field of heat and thermodynamics. The proposed tentative standard has received the approval of the sub-committee and is now being circulated with a request for criticism and comment. Communications may be addressed to Preston S. Miller, secretary of the sectional committee, 80th Street and East End Avenue, New York, N. Y.

Mathematical and aeronautical symbols, developed

under the direction of the same sectional committee, were released to the technical press for review on July 29, 1927.

MEETING OF THE AMERICAN MUSEUM OF NATURAL HISTORY

A board meeting of the trustees of the American Museum of Natural History was held on November 13. The business meeting was preceded by a luncheon given to the trustees by President Henry Fairfield Osborn at one o'clock. Besides reporting upon the general progress of the museum in its direct relation to exhibition and educational activities, the chairmen of the several departmental committees, headed by various members of the board, reported upon the several divisions coming under their particular charge This division of individual trustee responsibility is a new phase in the museum program, and the chairmen of the several committees are selected by reason of personal interest in the furtherance of the respective departments, *i e*, Dr J Hamilton Rice has assumed responsibility for the development of the halls of geology and geography, George F Baker, Jr, that of mineralogy and the Morgan hall of gems, Childs Frick, the department of vertebrate paleontology, Clarence L Hay, the department of Mexican archeology; Junius S Morgan, Jr., the Asiatic hall and Asiatic collections; Daniel E Pomeroy, the African hall and African collections, Kermit Roosevelt is assigned to look after an extensive exhibition covering the mammals of the world, Dr Leonard C Sanford similarly takes care of the birds of the world, George T Bowdoin, oceanic collections and the hall of ocean life The preparation of this particular section is proceeding rapidly and will form one of the most important parts of the museum's exhibitions. Cleveland E Dodge devotes his interest to a correct exposition of fishes, while Madison Grant has been assigned to the department of comparative anatomy, Ogden L Mills, who for a long time has manifested a deep interest in the expansion of literature pertaining to natural history, is assigned to the library and printing; Felix M Warburg, who is prominent and well-known throughout the state in educational circles, is in charge of education, and George D Pratt, who was formerly conservation commissioner of the State of New York, has been assigned to conservation

The trustees of the museum recently requested President Osborn to become curator-in-chief of the division of mineralogy, geology, geography and astronomy, and also assume the post of curator-in-chief of geology and paleontology, both of which he has accepted The trustees, by resolution, expressed their thanks to President Osborn for his generous action in contributing to the permanent endowment fund of the museum the sum of $5,000 recently presented to him on his seventieth birthday, which, in accordance with his wishes, they have set aside to the endowment fund to be known as the Osborn paleontological research fund, the principal of which is to be invested and the income used only for the advancement of research.

The present amount of endowment in hand is $12,-156,549, together with $2,004,500 contingent bequests, making a present and prospective endowment of $14,-167,049 To keep pace with the educational demands upon the museum, there is urgent need for the receipt of $5,832,951, which would be sufficient to raise the total permanent endowment to $20,000,000. Because of the lack of these funds, the preparation of new halls and the installation of new specimens is restricted. The interest on the endowment fund is used solely for scientific research, scientific exhibition and popular education, not for either maintenance or building

SCIENTIFIC NOTES AND NEWS

Dr H E Ives, of the Bell Telephone Laboratories, New York, and S. L. Kneass, mechanical engineer of Philadelphia, were presented with the John Scott medals and premiums of the Franklin Institute at a meeting on November 16

King Albert of Belgium has conferred a special agricultural decoration of the first class upon Dr C J Galpin, in charge of the division of rural life and farm population, U S Bureau of Agricultural Economics, Asher Hobson, collaborator of that bureau and permanent delegate of the United States to the International Institute of Agriculture at Rome, and Miss Grace F Frysinger, of the extension service.

Professor Emil Abderhalden, of Halle, and Professor Max Nonne, of Hamburg, have been nominated honorary members of the Royal Academy of Medicine at Rome.

Dr Samuel Avery, for nearly twenty years chancellor of the University of Nebraska, recently retired with the title of chancellor emeritus and professor of research in chemistry Dr Avery will have a laboratory in the chemistry building, where he will devote himself to writing and research

Sir Archibald Garrod has tendered his resignation of the office of Regius professor of medicine at Oxford University, as from December 31 next. Sir Archibald succeeded Sir William Osler in 1920.

Dr S. W. Parr, professor of chemistry at the University of Illinois, has been nominated for president by the executive committee of the Chicago section of the American Chemical Society.

DR. WILBUR A. NELSON, formerly state geologist of Tennessee, now professor of geology in the University of Virginia and state geologist of Virginia, was elected president of the Virginia chapter of the Society of Sigma Xi at a meeting held on October 17.

CLARE N. STANNARD was elected president of the Rocky Mountain Division of the National Electric Light Association at the recent convention in Colorado Springs.

ARTHUR H ADAMS, assistant superintendent of manufacturing development at the Hawthorne, Illinois, works of the Western Electric Company, Inc, assumes, on December 1, the position of technical adviser to the president of the Manhattan Electrical Supply Company, New York City

WALTER MCCLINTOCK has been appointed to a research fellowship in ethnology at the Southwest Museum in Los Angeles

PAUL T DIEFENDERFER, graduate student of the University of Chicago, has been appointed assistant in ethnology on the staff of the Bernice P Bishop Museum, Honolulu. His field of work will be Samoa, where the museum is conducting an ethnological survey Mr Albert F. Judd and Mr Bruce Cartwright, members of the Samoan expedition of the museum, have returned to Honolulu Dr Victor Pietschmann, ichthyologist in the University of Vienna and Bishop Museum fellow in Yale University, has arrived at Honolulu He plans a study of the larval and young stages of Hawaiian fishes

PROFESSOR ALBERT A. MICHELSON, head of the department of physics at the University of Chicago, has returned from Pasadena, California, where he had been attempting a repetition of his experiment on the speed of light Professor Michelson attempted to send a beam of light on a round trip of 164 miles, but was unable to do so because of haze and unsatisfactory weather conditions at the Mt. Wilson Observatory

AT the request of Dean J. L Hills, of the college of agriculture, University of Vermont, the U S Department of Agriculture has detailed Dr L. H. James, bacteriologist, and D. J. Price, engineer, to make special studies of the heating of hay in the barns of the flooded area in New England

DR. F. H H ROBERTS, JR, archeologist for the U S. Bureau of American Ethnology, returned from the field on October 21. Dr. Roberts has spent the summer excavating a post basket-maker village in northwestern New Mexico and doing reconnaissance work in southwestern Colorado and southeastern Utah. John P Harrington, ethnologist for the bureau, left for California on October 26 to continue his researches on the Mission Indians of that state.

AT the request of the Canadian Geological Survey and the United States and Vermont Geological Surveys, Professor B F. Howell, a member of the geology department at Princeton University, will make a special study of geological formations in Vermont next summer.

PROFESSOR G H CRESSE, of the University of Arizona, is spending his year of sabbatical leave at the University of Göttingen.

DR GUSTAV BERGFORS, of the University of Upsala, Sweden, is visiting the United States in the interest of work in physical anthropology

DR. MOSES GOMBERG, professor and head of the department of chemistry at the University of Michigan, will give the lecture on the Charles Frederick Chandler foundation in Havemeyer Hall, Columbia University, on December 16, at 8 15 P M Dr Gomberg's subject will be "Free Radicals in Chemistry—Past and Present"

AT a meeting of the New York University chapter of the Sigma Xi, on November 18, a paper was read on "A New Method of studying Stream Flow," illustrated by photographic exposures taken 20,000 per second, by Baron C Shiba, of the Aeronautical Research Institute of Tokyo. In the absence of Baron Shiba, the material was presented by Dr Alexander Klemin, professor of aeronautical engineering at New York University.

THE Astronomical Society of the Pacific announces four illustrated popular lectures on the general subject "From Atom to Island Universe," being given by Dr William F Meyer, associate professor of astronomy in the University of Berkeley, in the auditorium of the Pacific Gas and Electric Company, San Francisco. The final lecture of the series will be given on December 19 at 8 P M on "The Night Sky in Winter"

PROFESSOR JAMES KENDALL, of the department of chemistry, Washington Square College, New York University, delivered a lecture at Yale University on November 9 on "Rare Earths and Isotopes" He also spoke on November 18 at the Brooklyn Polytechnic Institute on "The Life and Work of Svante Arrhenius"

E. A. HODGSON, director of the Dominion Seismological Service, Canada, addressed the geological conference at Harvard University on November 15 on "Current Seismological Problems in Eastern Canada and New England."

REMINGTON KELLOGG, of the U S. Bureau of Biological Survey, will give an illustrated lecture in the administration building of the Carnegie Institution of

Washington on November 29 on the "History of Whales—their Adaptation to Life in the Sea."

Dr. John Johnston gave an appreciation of the work of Josiah Willard Gibbs at a meeting of the Yale chapter of Sigma Xi, which was held in the Sterling Laboratory of Chemistry on November 16. The semi-centennial of the publication of Gibbs's work is being celebrated in Germany, France and Holland The memory of Professor Gibbs will be perpetuated at Yale by the establishment of a permanent Gibbs endowment fund of $250,000, which has already been contributed

Dr. Charles Sumner Jones, dean of the medical school at the University of Buffalo, died on November 16, aged sixty-nine years.

Samuel Sanford, engineer, of the U S. Bureau of Mines, has died at the age of sixty-three years

Dr. Emil Bose, formerly of the bureau of economic geology of the University of Texas, died at Sabinal, Texas, on November 8, as the result of an automobile accident which occurred near Sabinal on September 9 At the time of his death Dr Böse was in the employ of the Standard Oil Company, of California, and was working chiefly in northern Mexico and adjacent regions in Texas

The Indiana Academy of Science will hold its next meeting at Notre Dame from December 1 to 3

The Beta Beta Beta National Biological Fraternity will hold its biennial meeting at the time of the meeting of the American Association for the Advancement of Science at Nashville

The offer of the Minnesota section of the American Chemical Society made at the Detroit meeting in September, to act as host for the national meeting in September, 1929, has been accepted

The council of the Society for the Promotion of Engineering Education has voted to hold its annual meeting at Chapel Hill during the week of June 25, 1928 This is the first time since the formation of the society in 1892 that it has held a meeting south of Richmond, and by doing so next year, recognition is made of the marked advances in engineering education in the South

The new botany building of Wellesley College was dedicated on November 4 with appropriate exercises A reception and inspection of the building at 10:30 was followed by a luncheon at Severence Hall. The guests returned to the lecture room of the new building for the afternoon program. President Pendleton opened the meeting with a word of welcome to the visiting botanists and a tribute to Professor Hallowell, founder of the department. Professor Margaret C. Ferguson, chairman of the department, introduced the speakers of the afternoon, who spoke briefly of their special fields, Professor Edward C Jeffrey on anatomy, Professor Karl M Wiegand on taxonomy, Professor George E Nichols on ecology, Dr Benjamin White on bacteriology and Professor Edward M East on genetics Dr W. W. Lepeschkin, dean of the Russian Peoples University, Prague, was scheduled to speak at Alumnae Hall at 4 30 on the "Chemical and Physical Composition of Protoplasm" On account of the flood conditions, his arrival was delayed until late afternoon and his address was postponed until after the dinner in the banquet room of Alumnae Hall The address of the evening was given by Dr C Stuart Gager, who chose for his subject "Wellesley College and the Development of Botanical Education in America."

The United States Civil Service Commission announces an open competitive examination for associate aquatic biologist at $3,000 a year, to fill a vacancy in the U S Bureau of Fisheries, for duty at Beaufort, N C Applications must be received not later than December 1

Plans for the new William H. Welch Library of the Johns Hopkins Medical School have been completed by Edward L Tilton, architect, of New York, and have been accepted by the university Work on the new building will begin at once and it is expected to be completed within ten months It will be erected near the School of Hygiene and Public Health, and will have a frontage of 156 feet and a depth of 70 feet The style is Renaissance with the exterior material granite and limestone. The library was made possible by a gift of $750,000 from the General Education Board, which also agreed to give an additional $250,000 for maintenance of the library and the chair of the history of medicine if the university would raise $500,000 for maintenance.

Removal of the Boyden station of the Harvard College Observatory from Arequipa, Peru, to Mazelspoort, South Africa, has been practically completed. A permanent establishment is to be erected on a hill several hundred feet above the plain on which Mazelspoort is situated, but pending the work of building a road to the permanent site, installing water and electricity and constructing a cement observatory, two or three of the smaller telescopes have been erected in the village. Dr. J S. Paraskevopoulos, who has been for the past three years in charge of the Boyden Station when it was situated near Arequipa, Peru, is directing operations at the South African post. There will be seven or eight research observers stationed at

Maselspoort when the Boyden Observatory has been completed, which will be about the middle of this winter.

The Secretary of Agriculture, W M Jardine, conferred on November 14 with a committee, representing thirteen national agricultural and industrial organizations, on the question of enlarging activities in fundamental research in the Department of Agriculture The committee, formed for the purpose of promoting agricultural research, is composed of Miss M B Bromberg, chairman, representing the American Sugar Cane League, the secretary of the American Dairy Federation, A M Loomis, and the director of the Northern Division of the National Fertilizer Association, H R Smalley The organizations interested in this movement, having a combined membership of over 2,000,000, are The National Grange, American Farm Bureau Federation, American Beet Sugar Manufacturers' Association, American Sugar Cane League, American Dairy Federation, American Seed Trade Association, Automobile Chamber of Commerce, Better Understanding Between Industry and Agriculture, National Canners' Association, National League of Commission Merchants, National Lumber Manufacturers' Association, Tanners Council of America and The National Fertilizer Association

The Italian *Gazzetta Ufficiale* publishes a royal decree providing for the reorganization of the National Research Council The purposes of the council are to coordinate national activities in the various fields of science and its practical applications, to make recommendations to the government concerning laboratories for general or special researches, to furnish, on request, information and opinions to government boards on scientific subjects, to collect Italian bibliographic data on scientific and technical subjects and provide also for their diffusion in foreign countries, and to propose to the government the creation of scholarships, not only for the homeland but also for foreign countries.

About $200,000,000 is being spent each year in the United States for industrial research by industrial corporations and by the federal government, according to figures compiled by the National Industrial Conference Board During the past six years the number of companies maintaining research departments or laboratories has increased from 578 to more than 1,000. Industries whose research expenditures were largest five years ago are those which have scored the greatest relative growth since then. In addition to industrial departments maintained by commercial organisations, the report states that 70 trade associations are spending about $15,000,000 a year in research and 152 colleges and technical schools about $1,500,000

To promote, encourage and aid scientific investigation and research at the University of Wisconsin and to assist in providing means and machinery by which scientific discoveries of the faculty, the staff, alumni and students may be applied and patented, is the purpose of a newly organized corporation which has taken for its name the Wisconsin Alumni Research Foundation This corporation, the management of which rests in a board of five trustees, has no capital stock, nor does it ever expect to pay either dividends or profits The Research Foundation was organized following the discovery by Professor Harry Steenbock that antirachitic properties can be imparted by irradiation to foods in which this factor is lacking or deficient in amount Dr. Steenbock is the first scientist to assign his invention to the foundation It has been reported that the trustees have negotiated a contract with the Quaker Oats Company under the terms of which patent applications and possible litigation and the designing and construction of the necessary machinery will be financed by the latter In return the Quaker Oats Company is granted the license to the Steenbock invention, for which it will pay a royalty which by the third year following the beginning of its commercial use will amount to $60,000 annually

Dean C F Baker, of the college of agriculture of the University of the Philippines, at Los Baños, who died early in July, left his extensive collection of insects to the U S National Museum This collection was formed by Professor Baker during his long residence in the Malay region It contains types of hundreds of specimens which have been determined by specialists throughout the world, and in addition to the determined material it contains a large quantity of unstudied specimens. The U S. Department of Agriculture has authorized one of its specialists, R A. Cushman, an associate entomologist of the Bureau of Entomology, to cooperate with the National Museum in arranging for the packing and shipment of the collection to Washington. Mr Cushman sailed from Seattle for the Philippines on October 11

Seven hundred and fifty grains of radium from the Belgian Congo was presented to the University of Lille, France, on November 16, by the executive committee of the Franco-Belgian Relief Fund as an acknowledgement of the money raised by the university to aid Belgian sufferers in the World War. The presentation was made by Prime Minister Jaspar and M Francqui, finance expert The radium will be devoted to research and experimental purposes.

The Reconstruction Hospital, of which Dr. William

Gilman Thompson formerly was president, receives $50,000 under the terms of his will. Dr. Thompson, who was professor of medicine at the Cornell University Medical College, also bequeathed to the New York Botanical Garden $5,000 and $10,000 to the New York Academy of Medicine.

UNIVERSITY AND EDUCATIONAL NOTES

NEGROES have given $150,259 to the $1,000,000 fund which has been raised for Howard University, Washington, to be devoted to the purpose of the medical school. Fifty-one Negroes gave amounts ranging from one thousand to ten thousand dollars

A LEGACY of £2,000, bequeathed by the late Christopher Collins to the University of Birmingham, is to be added to the biological building fund.

DR. MILO HELLMAN, research associate in physical anthropology at the American Museum of Natural History, has been appointed professor of comparative dental morphology at the New York University College of Dentistry.

ASSOCIATE PROFESSOR H J ETTLINGER, of the University of Texas, has been promoted to a full professorship of mathematics.

DR. J. R MAGNESS, physiologist in storage and transportation investigations of the U S Department of Agriculture, has been appointed head of the department of horticulture in Washington State College and of the division of horticulture in the experiment station.

DR THURMAN B RICE has been appointed associate professor of bacteriology and public health, and Dr. Frank Forry, associate professor of pathology at the Indiana University School of Medicine, Indianapolis

DR FREDERIC A. WOLL will head the department of hygiene of the College of the City of New York, beginning January 1

W. L. GILLILAND, national research fellow at Harvard University, has been appointed instructor in chemistry at the University of Maine.

H JENSEN, who has been connected with the department of chemistry of the University of Louisville as assistant professor, has accepted a position at the Johns Hopkins Medical School in the department of pharmacology in order to do research work on insulin

J O COOPER has been appointed lecturer in zoology at Armstrong College, Newcastle-on-Tyne, in succession to Dr A. D. Peacock, who is going to University College, Dundee, as professor of zoology.

DR. RALPH P SMITH has been appointed to a position in the pathology department of Dalhousie University Medical School, Halifax, succeeding Dr. Albert G. Nicholls, who has resigned. Dr G. S. Eadie has taken the position in the physiology department formerly occupied by Dr N. B. Dreyer Dr Louis M. Silver has resigned as professor of medicine

DISCUSSION AND CORRESPONDENCE

CONFUSING NAMES FOR A METEOR

Two contributors to SCIENCE have expressed themselves on the difficulty of extracting from supposedly intelligent people useful information on the fall of a meteor. When Mr Jones announces, perhaps in a scientific publication, that he saw a meteor with a head the size of a golf ball and a tail six feet long fall in broad daylight, which burst over Lake Cochituate at a height of one hundred feet, the exasperated investigator learns little except that the meteor did not burst over that lake

The purpose of this note, however, is to discuss another difficulty, that of several confusing names for the same meteor, and scientific men are themselves largely responsible for errors from this source. It has recently been intimated that much of the same confusion in another field results from the belief of certain individuals that coining a new name for a species is an easy way to gain publicity. We will discuss the treatment of a meteor which fell about twenty miles west of the University of Iowa on February 12, 1875, and the reader can judge for himself whether the publicity on the various new names suggested would be desirable.

This meteor fell in Iowa County, Iowa, largely on land owned by the Amana Society, with the closest towns the Amana villages of South Amana, High Amana and Middle Amana. Their chief village, Amana, and the other society villages, West Amana, East Amana and Homestead, are only a little farther away. Marengo is the closest town of any size.

Two University of Iowa men investigating the meteoric fall published preliminary notes, referring to it as the Iowa County meteor. A more definite designation is, however, desirable, and later in the year, when sufficient stones had been recovered to mark the field of the meteorites, one of the men published the name Amana, under which specimens were sent to Europe and the more complete monograph on the meteor published at a later date.

The preliminary note referred to the fall as occurring "near Marengo." As might be expected some picked on this as a name, and in modern catalogs Marengo is given as one of the alternate names for

the Amana meteor. This confuses the Amana meteor of February 12, 1875, with the Marengo meteor of March 27, 1894.

As was said before, the fall occurred some twenty miles west of Iowa City, and was investigated by men from the University of Iowa. Further, meteorites were shipped from Iowa City to various parts of the world. Hence the name Iowa City was attached It does not appear in the latest catalogs directly, but in Farrington's catalog of "Meteorites of North America" one finds for the position of the fall the longitude and latitude of the University of Iowa. So the error is still with us

The first stone recovered was found on the property of a Mr Sherlock, and this stone, important as the only one not exposed to the elements for some months, was referred to as the Sherlock stone Many were unable to grasp the distinction, and insisted on attaching the name to all the stones of the Amana fall. This is given as an alternate name in the latest catalogs.

When the extent of the meteoric fall became generally known, dealers sent representatives to the locality. These men made Homestead their headquarters, as that village is the most easily reached by rail of those conveniently near the fall The dealers secured many specimens, and we find the name of their trading post, Homestead, given preference in some of the late publications. A recent book showing a map of the vicinity of the fall, and using the name Homestead, marks the position of that village but fails to show Amana and the other villages of the vicinity

Several interesting items with no basis of fact appeared in the newspapers at the time The prize should be awarded to a story sent out from West Liberty, forty miles east of the fall, which told of a big stone buried fifteen feet deep found near that town. This story convinced many that the University of Iowa scientists had committed a grave injustice in failing to use the name West Liberty for this meteor At the St. Louis World's Fair of 1904, practically thirty years after the fall, the map of American meteorites showed the Amana fall as occurring at West Liberty. Even in Europe this has been given as the preferred name in museum catalogues.

C C. WYLIE

UNIVERSITY OF IOWA

FIREBALLS AND NEW ENGLAND SCIENTISTS

THE study of the bright meteors often called fireballs, so bright that they attract wide attention and excite great interest among masses of people, differs in an important respect from that of the shooting stars of lesser brilliancy. The latter are noted for their periodicity, and for occasional showers of very numerous small meteors with some fireballs intermingled. But fireballs are generally scarce and, while there are signs of periodicity, in many cases they are certainly not members of the solar system, but appear sporadically. These two facts, and the impressive swift glare, burning train and occasional loud noises bring it about that they are for the most part observed by unskilled and unprepared observers, whose reports have to be elicited by appeals through the press and the radio broadcasting stations. The original observations are in general made without focussed attention or expectation of making any report, and the reports are made after a lapse of time from memory.

Schiaparelli plainly stated the remarkable fact of interstellar meteors, and von Niessl and his successor, Hoffmeister, have extended his work in quantity, and have shown that in some cases it is possible to group interstellar meteors as members of interstellar swarms Continuous investigation of the facts is evidently highly desirable. This has been done in the United States by men of training and capacity from the time of Nathaniel Bowditch, and is now one of the functions of the American Meteor Society, whose president, Professor C P. Olivier, has at intervals lately published studies of these bodies It has, however, been plain that the whole continent is too large for one person or observatory to cover, and an attempt has been made to divide the United States and Canada into sections small enough for one institution in each. New England has been assigned to Harvard Observatory.

The object of this writing is to bring fireball observing to the attention of the readers of SCIENCE, and, in particular, to the attention of the New England members of the American Association for the Advancement of Science The hope is that they may interest themselves in observing and reporting very bright meteors, comparable with a bright planet at least.

The Harvard Observatory has already dealt with recent fireballs, which occurred on November 15, 1925, December 29, 1925, and August 10, 1927 The first fell on a Sunday morning, the others in evening twilight. The cue for collecting the data was in each case a press notice in the morning papers the day following the fall. The means used in each case was an appeal for reports by eye-witnesses circulated in the newspapers and in the first two cases by radio broadcast also. The response was in each case rather overwhelming; there were received, in order, 140, 260, 249 reports more or less to the point. In the first case only one meteor was certainly in evidence, its position was determined in a general way as over southern Oxford County, Maine, and it was shown not to be a member of the Leonid swarm. The second case was shown not to be simple, but composite, there having

fallen within a few minutes many strikingly bright meteors in New England, New York and Pennsylvania. Seven of these could be identified with considerable certainty, and for one of them the computation of a parabolic orbit and a study of the train were possible. The last case involved the fall of about forty bright meteors within a few minutes, almost all in the New England area. Of these only four could be dealt with in sufficient detail to determine ending heights.

The characteristic quality of the reports received is for the most part incompleteness, and even in some instances vagueness In the last case, about one hundred thirty hours were spent in acknowledging reports (by postal cards), in writing abstracts on index cards, to reduce the tedium of handling such varied stationery, and in sorting the observations into groups, each of which might reasonably be taken to represent a single meteor When this was done, there remained forty-four reports which were too vague to be grouped, the chief reason being lack of any indication of the time of observation, and thirty-eight reports which roughly stated the time of observation, but were nearly useless because of vagueness in the statement of direction Even among those grouped there were many uncertain

The useful results obtained in these campaigns are in no proper relation to the population reached by the appeals, or to the time and energy applied. The investigations are too much of a *post-mortem* nature. The hope for improvement lies in two directions one is the education of New England people to prepare them for fireball observation when fireballs come, the other is, the informing of the scientific personnel of the region as to what facts are to be noted while a fireball is in flight and immediately thereafter. By the wide-spread circulation of questionnaires whenever a fireball account appears in the papers, the population is being reached And the scientists of New England are begged to note the following

The important facts are, (1) duration of flight, (2) moment of apparition, (3) position of bursting or ending point, (4) apparent path Then, the phenomena of the flight, and the moment of arrival of the detonation, if any, if there is a train left behind, its position and its changes in form

(1) Seconds can be counted conveniently by the formula one thousand one, one thousand two, one thousand three . ., and the counting ought to be prolonged after the disappearance for comparison with the watch While it is often impossible to read the second hand, this should not be omitted in the day time, then (2) follows by back reckoning. Each person has his own rate of counting.

(3) This involves close observation of landmarks and of the observer's position, on road or hillside or verandah, to be followed up by a return to the point with simple instruments. Such are the pocket compass (whose reading should be given without correction for declination) and a home-made astrolabe.[1] Better than instrumental measurements like these are exact references to position among the stars, or with relation to the moon or the sun, or to the position of the shadow of the observer's head; especially if the angles are sketched on the spot.

(4) Memory sketches of the apparent inclination are excellent But the best record is of the apparent path and ending point among the stars. And no one should be frightened by a lack of knowledge of the constellations. In one instance a very accurate "fix" of a point on a meteor's path was given by a sketch of the path between two stars These were marked "large star" and "small star," and stated to be "in the west." Only Vega and Altair could match the sketch at the stated time, though the New York farmer who made it probably never heard of Vega or Altair

If fireballs would come only singly, the exact time of apparition might be of less importance for every single observer But when they are for several minutes peppered all over several states, and several hundred people write about them, times of apparition become vital, without them the observations can hardly be sorted Given time of apparition, the moment of arrival of the noise allows a calculation of the mean velocity of the sound and of the average temperature of the air along the sound-ray

The changes in form of meteor trains give us almost our only information about the winds of the highest atmosphere They should be noted and sketched carefully, and attempts should be made to photograph them This means a wide open lens and a moderately long exposure, and careful record of the moments of opening and closing A few photographic cross bearings on a great train would give valuable data, better than any visual work can.

WILLARD J FISHER

[1] This is a card (a postal card or one of that size is convenient), with a pinhole pricked through near one edge, from which hangs a plumb line The plumb line is a thread, pushed through the hole and fastened on the back, long enough so that the bob—a large button, a screw nut or a pebble—swings clear of the card One sights along the edge of the card, clips the line against the card with thumb or finger, and marks the direction of the vertical by a line on each side of the thread. The angles can be measured afterwards with a protractor. The card, without the thread, marked, with all records written on it, dated and signed, should go to the computer. There is a somewhat more elaborate form which the Harvard Observatory proposes to send out on return postal cards for use in fireball campaigns like those described above.

ON THE LOSS OF THE FIFTH TOE IN CERTAIN SALAMANDERS

DR. G. K. NOBLE (in Osborn, *Amer Nat.* LXI, p. 18, 1927) makes a statement regarding the loss of the fifth toe in salamanders which is liable to quotation and which is sufficiently misleading and general to merit correction. "There is abundant evidence in both the *Plethodontidae* and the *Hynobiidae* that the outer toe is usually lost at a single step (*i e*, mutation) and not by a gradual dwindling away"

Now there are forms in both families which never have more than four toes, and these of course give no evidence, but in the well-known species of *Hynobiidae*, which have either four or five toes, there are frequent cases of the fifth being rudimentary, which might mean a "gradual dwindling away" or rather that the loss of the fifth toe is, as are most size characters, due to several genetic factors, rather than to a single one

In 317 specimens of *H leechii*, there were ten cases of lack of fifth toe and two cases of a rudimentary one

In *H lichenatus*, of 50 specimens, there two cases of lack and fourteen of reduction

In *H sonani*, four specimens showed two cases of lack and six of reduction

In *H. tsuensis*, 184 specimens showed one case of reduction

H ikishimae showed three cases of loss and eight of reduction in a series of 179

In *nebulosus* ten specimens showed five cases of loss and five of reduction.

Thus twenty-two cases of complete loss are balanced by thirty-six of reduction, which makes it seem very much rather a "gradual dwindling away" in these cases than "loss at a single step"

For completeness sake it may be added that *H. keyserlingii* and its possible derivative *Batrachuperus* (with two species) always lack the fifth toe, and that one out of twenty specimens of *H kimurai* has a fifth toe, but that no reduced cases have been reported in it, and that one out of 14 *H retardatus* showed one case of loss. Schmalhausen (*Anat. Anz.* 37, p. 441, 1910) points out that in *keyserlingii* the fifth toe begins to develop, tarsale V developing only to fuse later with tarsale IV.

In the *Plethodontidae* two groups lack the fifth toe. *Manculus* with two forms derived from *Eurycea*, and *Hemidactylium* and *Batrachoseps* with several derived from *Plethodon*. No cases of reduction have been observed in *Eurycea*, or *Manculus* or *Hemidactylium*, and the loss here may be due to a single factor, but a specimen of *Batrachoseps attenuatus pacificus* (the most Plethodon-like type) has been reported by Van Denburgh (Proc. California Acad. Sci. (3), 4, p. 8) to have a rudimentary fifth toe.

The "abundant evidence" therefore, in the absence of which it would be permissible to suggest that the loss took place at a "single step," indicates rather that it took place at more than one step

Since this evidence is largely set forth in my monographs of the two families in question, which were Noble's source of information, it seems strange to meet with his statement I have therefore thought it appropriate to set down the known facts concerning digital loss in these families

E R DUNN

SMITH COLLEGE

COD-LIVER OIL FOR "SNUFFLES" IN RABBITS AND PNEUMONIA IN GUINEA-PIGS[1]

"SNUFFLES" has long been one of the deadliest diseases in rabbits The affected animals seem to have a very bad cold and as a result their nasal cavities are clogged with a heavy yellow discharge. In most cases death follows within a few days after the first symptoms appear Many practical rabbit breeders house their animals in outdoor hutches where they can be exposed to direct sunlight This keeps the animals in good health as far as snuffles is concerned The breeders seem to be of the opinion that the fresh air is responsible for the health of their animals It now seems that the ultra-violet rays in the sunlight bring about this effect.

Most experimenters with rabbits keep their animals indoors and for this reason are not able to expose them to sunlight. Experience here shows that when two per cent of cod-liver oil is fed with the grain ration the same effect is produced as by direct sunlight. The grain ration fed is made up mostly of rolled oats, a good absorbent of the oil In severe cases in which the animal is too weak or unwilling to eat the grain, it has been found serviceable to administer several cc. of the pure oil by means of a medicine dropper When this is inserted into one corner of the mouth there is no difficulty experienced in causing the animal to swallow

The oil replaces sunlight because of its high vitamin D content, this vitamin having approximately the same effect as ultra-violet rays. The vitamin A content is high also, but is not of very great importance since the alfalfa hay fed the animals furnishes it in sufficient quantity. When green alfalfa is fed the animals during the summer months they do not die of snuffles, but a considerable number cough, indicating that the vitamin D in the green alfalfa is not quite high enough to act as a complete preventive

[1] Contribution No 72 from the Department of Animal Husbandry

Upon occasionally adding to the ration the usual amount of oil the cough ceases, and complete protection is afforded.

Rabbits have a certain form of snuffles known as nasal coccidiosis This type has not been known to occur in the colony here and therefore it can not be stated to what extent the oil would act as a preventive

For the past three winters the addition of the oil to the grain ration of guinea-pigs has been found very beneficial The losses from pneumonia have been cut down very appreciably and there has been a general improvement in vitality In previous years the animals were fed sprouted oats in addition to their grain and hay, but this was not sufficient The sprouted oats is high enough in vitamin C to prevent scurvy but is either lacking or very low in vitamin D. When the latter was supplied by means of cod-liver oil the ration became comparatively perfect.

The feeding of liberal quantities of green alfalfa to guinea-pigs makes them practically immune to pneumonia It would seem from this that for guinea-pigs the above green feed has sufficient vitamin D for protection. Either green alfalfa is higher in vitamin D than sprouted oats or, if it is not, protection is afforded because it is fed in much larger quantities.

There is still another possibility and that is that green alfalfa may be entirely or almost entirely lacking in vitamin D but contains some other substance which acts as a good substitute in building up resistance to either pneumonia or snuffles

The present report is not intended to represent experimental work in nutrition but merely the observations of one interested in raising healthy animals for experimental work in other lines, in this particular case, genetics

Heman L. Ibsen

Kansas Agricultural
Experiment Station

THE SCIENTIFIC PAPERS OF WILLARD GIBBS

During the last few months I have been trying in vain, both in this country and in London, to acquire a copy of Willard Gibbs's "Scientific Papers" (Volume I) It is certainly a sad commentary that in this age of cheap printing, when tons of printers' ink flow daily to record and disseminate the most trivial incidents, the scientific papers of the greatest physical chemist America has produced should be unavailable to those who need them.

It can not be said that Gibbs's papers are of historical interest only Unlike most scientific publications of fifty years ago, his writings on thermodynamics are as useful to-day as they were when first published. Those who have patiently labored through his admittedly difficult writings are agreed that we are far from having exhausted the valuable material which lies hidden therein.

The publisher who would bring out a reprint of the old edition of Gibbs's papers would certainly perform a service to science. In the meantime, I shall be greatly obliged if any reader can inform me where a copy of the old edition can be bought.

Since writing the above, I have obtained from Professor R. G. van Name, of Yale University, through the kind offices of Dr A W Kenney, a copy of the German edition of Gibbs's "Thermodynamische Studien" edited by Wm. Ostwald in 1892. I understand that Professor van Name, who is a near relative of Willard Gibbs, will bring out next year a new edition of Gibbs's Scientific Papers

Victor Cofman

Chemical Department,
E. I du Pont de Nemours & Co.,
Wilmington, Delaware

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A SPECIAL FEATURE OF THE SECOND NASHVILLE MEETING. SCIENCE FOR THE PEOPLE

Increasingly from year to year we witness the further correlation of isolated scientific facts into broad "laws" of economic value and the application of these "laws" to the welfare of the people as a whole. Curious phenomena not known outside of laboratories twenty years ago combined with others equally uncanny are found to form broad basic principles which in one way or another influence the daily lives of each and every one of us. With this development there has arisen in the public mind a keen desire for enlightenment in regard to science as a whole, as well as in regard to each of the various branches into which it is divided

In order to progress science must find support. A century ago science was supported chiefly by the scientific men themselves, because they alone appreciated the importance and the potential value of scientific work. Then others became interested, and still later industry took a hand, while at the same time the people as a whole began to accord generous support to scientific institutions, especially to those of their own creation. At the present time science in this country, and indeed everywhere, is very largely supported by the general public, either through money derived from taxes or by numberless direct donations.

With the growing support of science by the people goes hand in hand an increasing responsibility of science to the public. The people have a right to be informed of the facts of science, of the progress that is being made, and of what science means to them. Science can no longer stand aloof At the present time one of the very greatest scientific needs is closer contact with the world at large—a better understanding between the scientific workers and those by whom most of them are supported

For the Nashville meeting of the American Association and Associated Societies there has been arranged as a general session, a symposium on the broad subject of publicity for science, that is, the broad problem of furnishing to the people the information that they wish and to which they are entitled. Those taking part in the symposium, which will probably occupy both forenoon and afternoon of Wednesday, December 28, are to discuss the subject from the points of view of. (1) the worker in pure science, (2) the publisher of standard scientific books, (3) the publisher of popular scientific books, (4) the editor of popular scientific magazines, (5) the editor of a commercial scientific journal, (6) the newspaper syndicate, (7) the feature writer, (8) the local newspaper, and (9) Science Service.

Another general session at the approaching Nashville meeting will be devoted to an address on "Science and the Newspapers," to be given by Dr William E. Ritter, organizer and till recently director of the Scripps Institution of Oceanography at La Jolla, California. Dr Ritter is well known to zoologists and to biologists generally. He will discuss some fundamental aspects of the question of newspaper diffusion of scientific knowledge

AUSTIN H CLARK,
News Manager for the Nashville Meeting

THE THOUSAND-DOLLAR PRIZE TO BE AWARDED AT NASHVILLE

AN interesting feature of the annual meetings of the American Association and Associated Societies is the award of the American Association Prize. This award attracts the attention of the intelligent public generally as well as of professional science workers and other people specially interested in the advancement of knowledge. If not quite peculiar, it is at least unusual, for eligibility to consideration consists solely in presenting a noteworthy contribution at the annual meeting in convocation week and there are no restrictions as to subject. The prize is surely a very valuable thing in American science. The funds by which it is made possible have been given to the American Association by a very generous member who does not wish his name made public. Its concrete purpose is to help toward further scientific accomplishment some research workers who have already made a really noteworthy contribution. It is hoped that this financial help may make it possible for prize winners to continue their work on a high plane of scientific scholarship Four annual awards have been made. Cincinnati, 1923–24, Washington, 1924–25; Kansas City, 1925–26; Philadelphia, 1926–27. The fifth award will be made at the close of the approaching Nashville meeting

The following rules for the award of the prize have developed from the experience of four years. They have been approved by the executive committee of the association and are in effect for the Nashville award.

1 To be considered by the Committee on Prize Award a paper must have been read at a session of one of the several sections or at a session of one of the organizations meeting with the association at the annual meeting at which the award is made

2 Any paper is to be considered only on the basis of work already accomplished, as represented by a finished manuscript, but it may be in part or in whole a summary of work that has been recently published elsewhere

3 Secretaries of sections and secretaries of organizations meeting with the association are asked to send in to the Committee on Award, as early in the meeting as possible, nominations or suggestions as to what paper or papers of their respective programs should be considered by the committee These suggestions are to be in writing and are to be sent in to the registration office, from which they are to be immediately transmitted to the committee

4. A paper may have the recommendation of a section committee, or of a special committee organized by a section, for the consideration of worthy papers

5 The prize winning paper should represent a noteworthy contribution to the advancement of science The Committee on Award is not to make any special attempt to select the *best* paper presented at the meeting

6 Authors of papers considered need not be members of the American Association for the Advancement of Science, nor members of any associated organizations

7 It is generally undesirable that the prize go to the same field of science, or to closely related fields, in two consecutive years

8 Younger workers are to be generally considered before workers who are already well known for scientific research

9. Under no circumstances is the prize to be divided, it is a single prize of $1,000

10. The Committee on Award is to report the award to the permanent secretary either on the evening of the next to the last day of the meeting period or on the last day. (Usually there are very few sessions held on the last day, which is often Saturday) The report is to be in writing, signed by the chairman of the Committee on Award. Under no circumstances is the award to be reported to the permanent secretary later than the last day

of the meeting period, which is to be Saturday for the second Nashville meeting

11 During the deliberations of the Committee on Award, and until public announcement is made by the permanent secretary, the utmost secrecy is to be maintained Even slight hints regarding possible prize winners are not to be released in any way before the award is announced. Announcement is made to all news agencies at once, by the permanent secretary through the news manager for the meeting

The Committee on the Award of the Nashville prize consists of the members named below

William H Roever, *chairman*, professor of mathematics, Washington University, St Louis, Mo

Roger Adams, professor of chemistry, University of Illinois, Urbana, Ill

William Duane, professor of biophysics, Harvard University, Cambridge, Mass.

Charles Schuchert, professor of paleontology, Yale University, New Haven, Conn

Robert J Terry, professor of anatomy, Washington University, St Louis, Mo

BURTON E LIVINGSTON,
Permanent Secretary

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN AGAR MEDIUM FOR PLATING L. ACIDOPHILUS AND L BULGARICUS

EXPERIENCE has demonstrated that *L acidophilus* grows poorly in ordinary peptone sugar agar and that many strains of typical *L bulgaricus* will not develop at all in this medium Rettger and Cheplin[1] (1921) employed whey agar in their experiments. The addition of galactose to this medium has been found[2] (1922) to increase its value The author[3] (1924) developed a casein-digest, milk powder-digest, galactose agar which proved to be quite satisfactory for colony study

Further investigation has indicated that some strains of *L acidophilus* and *L bulgaricus* attain the best colony development in whey-galactose agar, while others reach their optimum growth in digest-galactose medium As a rule, *L bulgaricus* grows best in digest galactose agar. In order to insure satisfactory results, it has been necessary to employ both kinds of media in the study of *L. bulgaricus* colonies.

From the standpoint of the dairy laboratory, or of any laboratory, where occasional platings of these species are carried out, some objection has been raised to both the whey and the digest media because their preparation is rather difficult. A more simple medium and one which is easily prepared has appeared quite desirable

While studying the effect of tomato juice upon the growth of different bacterial species, the author found that the addition of tomato extract to whey-galactose agar brought about a marked increase in the size of *L acidophilus* colonies grown on the medium, and that it accentuated the x type colony characteristic Further investigation showed that a medium containing tomato juice, peptone and agar fostered the development of as good colony growth as the more complicated media.

Experiments were carried out with the object of determining what proportions of peptone and tomato juice were necessary for optimum colony development.

The tomato juice was secured by filtering the liquid portion of canned tomatoes through filter-paper. Media were prepared containing 0 5 per cent. and 1 per cent peptone and varying proportions of tomato juice

The agar was prepared in the following manner.

Formula

Difco peptone
Tomato juice
Water to make 1,000 cc.
Adjustment to pH 7 0
Agar—10 grams

Autoclave to dissolve agar, filter through a thin layer of absorbent cotton, distribute in desired containers, and sterilize by autoclaving at 15 lbs steam pressure for 15 minutes The reaction of the finished product is about pH 6 5

Comparative platings were made, employing 24 hour-old milk cultures of 12 strains of *L acidophilus* and 8 strains of *L bulgaricus*. All agar platings were incubated in an atmosphere containing approximately 10 per cent. CO_2[4] (Kulp, 1926) for 48 hours. Whey-galactose and the digest-galactose agar platings of the same species were carried along under the same conditions as controls.

The results of this experiment and several others of like nature indicate the following:

1 Agar plating of *L acidophilus* and *L bulgaricus* made with an agar containing the proper concentra-

[1] Rettger, L F, and Cheplin, H A, 1921, "The Transformation of the Intestinal Flora, with special reference to the Implantation of Bacillus Acidophilus," Yale University Press

[2] Rettger, L F, and Kulp, Walter L., 1922, "A Note on the Choice of Culture Media for the Study of Lacto bacillus, with special reference to the Carbohydrates employed," *Abstracts of Bacteriology*, Vol 6, p 24

[3] Kulp, W L, and Rettger, L F, 1924, "A Comparative Study of *L acidophilus* and *L. bulgaricus*," *Jour Bact.* 9, 357–394.

[4] Kulp, W. L., 1926, "The Determination of Viable Lactobacillus Acidophilus," SCIENCE, Vol. 64, pp. 304–306.

tion of tomato juice bring out the optimum colony development of these two species In all cases, this medium is as acceptable as whey-galactose agar or digest-galactose agar, and as a rule it is preferable since the colonies of many strains on the tomato agar are decidedly larger and more characteristic than on either of the other media.

2 Incubation in an atmosphere containing approximately 10 per cent CO_2 is desirable for agar platings of both species

3 Two hundred to four hundred cc tomato juice per liter plus 1 per cent Difco peptone produces the most satisfactory medium

4. Agar platings of *L bulgaricus* strains which are very exacting in their growth requirements should be incubated for 72 hours

No satisfactory explanation can be offered for the growth-stimulating effect of tomato juice upon *L acidophilus* and *L bulgaricus* unless it be in the light of an "accessory substance or substances"

Both of these species require carbohydrate for growth The amount of sugar in tomatoes varies from two to four per cent, it is made up chiefly of hexoses Two hundred to four hundred cc of tomato juice per liter fully satisfy the carbohydrate requirements of these organisms.

However, *L acidophilus* develops poorly in ordinary nutrient agar containing added hexoses, and many strains of *L bulgaricus* will not grow at all in such a medium, no matter what sugar is present. There must be some other factor in tomato agar, therefore, in addition to the carbohydrate, which stimulates the growth of these organisms.

Walter L. Kulp
Laboratory of General Bacteriology,
Yale University

SPECIAL ARTICLES

THE ORIGIN AND DISTRIBUTION OF SCIENTIFIC MEN

The fourth edition of the Biographical Directory of American Men of Science, which will be published in December, contains an appendix describing the methods that were used to select the scientific men who are designated in the book as those whose contributions to science have been of the greatest value. There were added in the third and fourth editions (1921 and 1927) 601 names to the thousand first selected in 1903 and reselected in 1909. In the book there will be given a statistical study of the origin and distribution of these scientific men, and it may be worth while to print in Science some of the data.

In the production of the 601 scientific men New York leads with 67, followed by Ohio with 49, Massachusetts with 48, Illinois with 45 and Pennsylvania with 41. The group of states next following consists of Iowa 27, Wisconsin 24, Missouri 21. The position of the North Central States is noteworthy, and is further emphasized by the situation in states having a productivity between 10 and 20, namely, Indiana 18, Connecticut 16, Minnesota 14, Maryland 13, Michigan 13, California 11, Kansas 11. The number of scientific men coming from the South Atlantic, South Central and Western divisions is small, though there has been some gain since 1903

Of the leading thousand scientific men selected in 1903, Massachusetts produced 134 and Connecticut 40 At the time of their birth Boston was the intellectual center of the country New York in proportion to its population had then produced about half as many scientific men as Massachusetts and Connecticut, the North Central States about one third as many The situation had changed for the list of 1910 Reduced to comparable figures the birth rate of leading scientific men per million of population had fallen in Massachusetts from 109 to 85, in Connecticut from 87 to 57 In Michigan it had increased from 37 to 74, in Minnesota from 23 to 59, in Wisconsin from 45 to 54 The intellectual fecundity of the North Central States, as compared with New England, has now further increased, extending westward and southward to Iowa, Missouri and Kansas.

If the 601 scientific men are increased to 1,000 proportionately distributed, which is approximately the result that would have been obtained if 1,000 had been selected, the gains or losses of each state may be found The situation in New England is ominous for the future Every state has lost and it appears that the rural population is becoming intellectually sterile. Of the thousand leading scientific men in 1903, Maine had produced 29, of whom 19 ranked in the first 500 Of 601 scientific men mostly born less than 50 years ago, the state has produced six; if a thousand had been selected the most probable number would have been ten It has consequently lost 19, two thirds of its productivity. Massachusetts has lost 54. Analogous conditions obtain in all the New England States and southward along the Atlantic. The losses of New York, New Jersey and Maryland, in spite of, or it may be because of, their enormous increase in wealth, are startling Pennsylvania and Delaware remain nearly stationary; there are small gains in most of the South Atlantic and South Central States.

The losses of the eastern states are counter-balanced by the gains of the central states, notably Illinois, Minnesota, Iowa, Missouri, Kansas and Nebraska. All the central states have gained except Michigan,

though the gains in Ohio and Indiana are small. These three are the most eastern of the states and appear to be following in the wake of the Atlantic seaboard Further to the west there tend to be moderate gains which predict a large future development So indeed westward does the course of science take its way, but it is not gratifying if the eastern states do not equal the cultural nations of Europe before losing their leadership This may indicate a waning of the world's great era in science.

Ten of the scientific men on the list of 1921 have died, giving an annual death rate of 4 7 per thousand, which is about normal for men of that age. Of the 591 remaining on the lists of 1921 and 1927, 122 live in New York, 57 in Massachusetts, 52 in Illinois and 47 in California If the numbers are increased to 1,000 and proportionately distributed, it appears that in comparison with the thousand of 1906 Massachusetts has lost 49, whereas Illinois has gained 24 and California 23 Every New England state, as also New Jersey, Maryland, Virginia and North Carolina, have a smaller proportion of these leading scientific men than they had 21 years ago. New York has gained 11 Pennsylvania has lost two Next to Illinois and California, Minnesota has the largest gain The smaller gains or losses in other states show the real situation at the time and are significant, especially in view of the grouping by regions

When we compare the birth places and residences we find that New York has acquired 55 more of the scientific men than it has produced, the individuals of course not always being the same Massachusetts has gained 9, Connecticut 4, New Jersey 10 and Maryland 10, these representing men called to the universities. Illinois for the same reason has gained 7, Michigan 5 and Minnesota 4. In the other central states the loss has been large One hundred and sixty, more than one fourth, of the scientific men were born in them and only 55 reside there There are but few scientific men born in Washington while many are employed in that city by the government. Of the new group, three were born in the District of Columbia and 76 reside there Eighty-six of the scientific men were born abroad, so they more than supply the excess in Washington and the balance remains nearly even for the different states

In 1906 one half (501/1,000) of the leading scientific men of the United States resided in the North Atlantic States and somewhat more than one half (518/993) had been born there In the short period of 26 years the proportion of those born in these states has fallen to one third (200/598) and the percentage of those residing there to 44.5 per cent (263/591) The cities of the eastern seaboard depend in large measure on Europe for their population, on the central west for their wealth and for their leaders. They will face a difficult situation when immigration is nearly cut off and centers of wealth and culture develop toward the west. It might be supposed that as wealth increases in the hands of a plutocracy, so scientific and other culture would increase in its centers. There has obviously been no change in native ability in the course of a few years The only suggestion here made is that the state universities and denominational colleges of the central and western states are more nearly in touch with the people than the privately controlled universities of the east and have proved to be the better agencies for the selection and training of those having ability and ideal interests

The eastern universities provide education for more men who become leaders in science than the states produce As American students formerly went to Germany for advanced work, so in a later period they tended to congregate in the endowed universities of the Atlantic seaboard The first degree of doctor of philosophy in the United States was given by Yale University in 1861, the first scientific man to receive it being Josiah Willard Gibbs in 1863 Prior to 1876, Yale had given 18 doctorates in the sciences, Harvard 4, Columbia and Cornell 2 each Then was established the Johns Hopkins University, opening a new era of higher education and scientific research in the United States. In the following 20 years the Johns Hopkins conferred 179 doctorates in the sciences and 84 of the recipients (some had died) were on the list of 1,000 scientific men of 1910 During this period Columbia conferred 67 such degrees, Harvard 66, Yale 56, Cornell 33, Pennsylvania 22, Clark (opened in 1888) 21, Chicago (opened in 1892) 8, all other universities 66.[1]

Up to and including 1910, the universities of the United States had conferred 2,513 doctorates for work in the sciences, the distribution being. Johns Hopkins 434, Chicago 276, Yale 271, Columbia 268, Harvard 267, Cornell 222, Pennsylvania 172, Clark 150, all others 453. Thus eight endowed universities awarded more than four fifths of these degrees In 1926 according to data compiled for the National Research Council by Callie Hull and Clarence J. West there were 740 doctorates conferred in the sciences, the numbers for the leading institutions being: Chicago 78, Wisconsin 53, Johns Hopkins 50, Columbia 49, Illinois 44, Cornell 43, California 38, Yale 38, Har-

[1] These statistics concerning doctorates in the sciences are from an unpublished study. From 1898 to 1915 there was printed each year in SCIENCE an article on doctorates conferred by American universities, including the names of the recipients and the subjects of the theses in the natural and exact sciences.

vard 35, Washington 32, Minnesota 30, Iowa 28, Ohio State 25. Thus Chicago in the central west is far in advance of the eastern privately controlled universities and the seven eastern universities which had conferred prior to 1910 nearly three quarters of all the degrees in 1926 conferred fewer than seven state universities of the north central states and California.

Of the institutions from which the 601 scientific men received their degrees, Harvard with 41 bachelors, 62 doctors of philosophy and three doctors of medicine, stands foremost as it did in 1903 It is, however, now surpassed by Chicago in the number of doctorates, as it was by the Johns Hopkins at the earlier period After these three universities comes Columbia, followed by Yale, Pennsylvania, Cornell and California The institutions whose graduates are in the twenties are Michigan, Minnesota, Princeton and the Massachusetts Institute, ranging from 18 to 12 are Wisconsin, Stanford, Indiana, Kansas, Illinois and Ohio State The privately endowed universities still lead in the number of scientific men for whose education they were responsible usually some twenty to twenty-five years ago They probably do not do so for the men graduated to-day, but we must wait another twenty years before the figures will be at hand Many of the 41 bachelors who received degrees from Harvard and the 15 from Columbia and from Yale went to these universities from other institutions after they had planned their careers and the influence of the eastern endowed universities in the creation of scientific men is not large The private colleges are also losing the influence that they formerly had In the thousand of 1906 there were 23 graduates of Princeton and of Amherst, 16 of Wesleyan, 14 of Williams, 10 of Dartmouth and of Oberlin For the contemporary list of 601 men the numbers are Wesleyan 8, Princeton, Dartmouth and Williams 5, Amherst 4, Oberlin 2

Another change that can not be regarded as wholly auspicious is the small number of the younger scientific men who have studied at foreign universities In so far as this means such advance in our own institutions that it is needless to go abroad for special work it is gratifying. But it may result in lesser devotion to the ideals of scholarship and research that had their florescence in the German university of the nineteenth century. Of the thousand of 1906, 117 had studied in Berlin, 84 in Leipzig, 69 in Gottingen, 56 in Heidelberg, and a large proportion had received degrees from these and other German universities. Of the contemporary 601 only one has a degree from Berlin, none from Leipzig. This refers, of course, to men working in the period preceding the war Perhaps now the various systems of unattached fellowships may lead to a larger international interchange of students. Before graduate students can afford to study abroad, we must, however, find a method by which younger scientific men receive positions in accordance with their ability rather than through the influence of the professors with whom they work.

The majority of scientific men still find their careers in universities 358.5 (the decimal here and elsewhere referring to a divided position) of the 591 men hold academic positions and in the main earn their salaries by teaching There are 95 connected with the research institutions that are the most notable development in scientific investigation of the present century. Sixty-two are engaged in industrial work, largely in the research laboratories of the corporations, where their work is not confined to applied science and will doubtless be more and more extended to the fundamental problems whose cultivation and by-products have an economic value far beyond their cost. Such work is besides only a proper return to society for the wealth acquired by monopoly A public service corporation such as the American Telephone and Telegraph Company, whose profits are limited only by legal regulations, could easily and properly support and give the best facilities to scientific men engaged in research in physics, chemistry, mathematics and psychology 74.5 of the men are employed by the government. Here again the work is largely but not wholly in applied science, and here again the most beneficial use of money collected by taxation would be the support of research that of all services is the most important for the nation and for the world.

Of these scientific men 60 7 per cent hold academic positions as compared with 73 8 per cent. of those in the list of 1910. It has been recognized that there has been since the war a movement of scientific men from the universities to the research and industrial laboratories and we have here a measure of its extent. If the numbers are, as above explained, increased to a thousand we find that of this younger group the universities and colleges have lost 133 The research institutions have gained 88 5, the industrial laboratories and applied science 46, the government services 14 5 There is only one who may be classed as an amateur in the present list, as compared with 18 in 1910 We have never had in America a group of men, such as was represented in England by Darwin, Galton, Rayleigh and Huggins, who devoted themselves to scientific work without occupying a scientific position. The specialization of science and democratic institutions have now led to the practical disappearance of those who contribute significantly to the advancement of science without being professionally engaged in scientific or educational work. But we now have men who are professionally engaged in research.

The figures for the separate sciences show that nearly all mathematicians are teachers. Astronomy and pathology are especially well represented in the research institutions, geology and to a lesser extent physics, botany and zoology, in the government work, physics and chemistry in the industrial laboratories and applied science

In treating the number of scientific men connected with different institutions we are in the main concerned with the present strength of the institutions rather than with changes in distribution, so all the scientific men are included We have 1,176 instead of 1,000 as in the earlier lists. The competition for inclusion is now, however, more severe, for the list of 1906 included about one fourth of the scientific men of the country, whereas the present list includes only about one twelfth The figures given are consequently relative An increase of about 17 6 per cent means that an institution has remained stationary in its relation to other institutions

Harvard has on its faculties 89 5 of these leading scientific men and has gained 23 since 1906 Under the existing system of university administration honor should be given to Mr Eliot and Mr Lowell for maintaining high academic traditions In 1906 Harvard had 66 5 of our thousand leading scientific men, Columbia 60, and Chicago 39 Now of 1,176 leading scientific men Harvard has 89.5, Chicago 53 5, and Columbia 46.5 It should also be noticed that Harvard has 21 of the younger men of the group of 250, as compared with 15 at Chicago and 7 at Columbia. Following these three universities are Yale with 42 5 and California and the Johns Hopkins bracketed with 40 5 Cornell, which comes next, has lost relatively There then follow the three state universities, Michigan, Wisconsin and Illinois, of which Illinois has gained the most Next come four endowed institutions, Stanford, Pennsylvania, Princeton and the Massachusetts Institute of Technology Washington (St Louis) is in the same group and has the largest gain The only other universities having ten or more of these leading scientific men are Minnesota and the Ohio State Apart from Columbia the universities that have lost most relatively are Missouri, Wesleyan, Syracuse, New York and Virginia

The past twenty-six years have witnessed the development of endowed research institutions and the Carnegie Institution of Washington now stands next to Harvard and Chicago in the number of its scientific men of distinction. The Rockefeller Institute, limited to medical research, has also attained a high position In this period the Carnegie Institution has grown from 7 to 47, the Rockefeller Institute from 3 to 19. The Boyce Thompson Institute, the Wistar Institute and the Mayo Clinic also show gains. The American Museum of Natural History and the New York Botanical Garden, with respectively 13 and 8 of the scientific men, rank before most universities and show a gain since 1906. It is of interest that these institutions can flourish under support and control partly private and partly public

The industrial laboratories of the corporations, like the endowed institutions for research, have enjoyed a notable growth which is scarcely measured by the 11 men recorded for the General Electric Company, the 10 for the Bell Laboratories and other parts of the Telephone System and the 5 for the Eastman Kodak Company Industrial research, like advances in engineering, is not always recorded in scientific papers, and is often a cooperative undertaking for which credit is not assigned to individuals. It is, however, to be noted that the number of leading scientific men under these three corporations has greatly increased and of 26 all but three belong to the group consisting mainly of younger scientific men

The Bureau of Standards has during the period increased the number of leading scientific men in its laboratories from 8 to 23 The Geological Survey, with 28 5, is the strongest group in a single science, but relatively it has lost ground somewhat since 1906, as has also the Department of Agriculture. The Smithsonian Institution, with its government supported subsidiaries, has remained stationary, but this means a moderate relative loss. The U. S Public Health Service has gained and some states and municipalities are now cooperating in this work.

In the book a table is printed showing the ten strongest departments in each science and their gain or loss since 1906. Harvard shows its leadership not only as a whole but in nearly every department. It stands first among universities in physics, chemistry, geology, botany, zoology, physiology and pathology, second in mathematics, third in astronomy and psychology, fourth in anthropology There has been a gain since 1906 in every department except anatomy and psychology, though in several cases the gains are due only to the increased number of individuals on the present list. Chicago stands first in mathematics and second in zoology Columbia stands first in psychology, but does not in any other science have a rank higher than fifth The U S Bureau of Standards leads in physics and the Bureau of Ethnology in anthropology By a wide margin the Carnegie Institution leads in astronomy, the U S. Geological Survey in geology, the U. S Department of Agriculture in botany and the Rockefeller Institute in pathology.

J. McKeen Cattell

Garrison, N. Y.,
November 1, 1927

SPECIAL ISSUE CONTAINING THE PRELIMINARY ANNOUNCEMENT OF THE SECOND NASHVILLE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES, DECEMBER 26-31, 1927. EDITED BY BURTON E. LIVINGSTON, PERMANENT SECRETARY

SCIENCE

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PRELIMINARY ANNOUNCEMENT OF THE SECOND NASHVILLE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES

THE ANNOUNCEMENT AND THE GENERAL PROGRAM

This special issue of SCIENCE is sent to all members of the American Association, whether they regularly receive this journal or *The Scientific Monthly* It contains general and specific informa-

> Those planning to attend the second Nashville meeting should arrange for lodging accommodations at once The meeting is to open on Monday evening, December 26 A list of hotel and dormitory accommodations that will be available for this meeting, including information as to prices and showing the lodging headquarters for many of the sciences, appears in this issue of SCIENCE. See also the section on Organizations and that on Sessions of the Sections, in this issue
>
> All who are to present papers at Nashville, whether association members or not, should send their manuscripts to the permanent secretary's office (Smithsonian Institution Building, Washington, D C.) as soon as possible A second copy of each paper should be sent to *Science Service* (21st and B Sts., Washington, D C) and a third copy to the society or section secretary in whose program the paper is to be presented
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> When purchasing the railway ticket to Nashville each purchaser should secure from the railway ticket agent a certificate for the meeting of the American Association for the Advancement of Science and Associated Societies See the section on Railway Transportation, this issue of SCIENCE
>
> Life members of the association and annual members who have paid their dues for the current year should bring with them to Nashville their blue membership cards, which identify them as in good standing for the association year 1927–28.

tion about the second Nashville meeting The complete general program of the meeting will be available at the registration offices at Nashville, in the Andrew Jackson Hotel, on Monday, December 26, and throughout the week. Registration will begin at 9 on Monday Members of the association who do not attend the meeting may each secure a free copy of the general program promptly if they request it from the permanent secretary's office, Smithsonian Institution Building, Washington, D C, provided that their dues for the association year 1927–28 have been paid Requests should be received by December 22. If received later, they can not be given attention till after the close of the meeting

THE VALUE OF THE ANNUAL MEETINGS OF THE ASSOCIATION

One of the chief ways by which the American Association aids the advancement of science consists in the holding of these annual meetings,[1] preparations for which now begin more than a year in advance in every case They are large and complex, for they embrace nearly all of the broader fields of scientific study.

For the cultivation of some of the special sciences they are not in recent years so important as they once were, for each branch of science now has its own special American organization and many of these organizations now meet at other times or at other places Some of them still meet regularly with the association, however, and others do so occasionally, especially at the larger four-yearly meetings, one of which occurs at the close of each leap year The organization of the association is available as an aid to the societies that desire to hold meetings in the general convention of convocation week and the association undertakes to provide facilities for all these With the aid of the local committees for each annual meeting it cares for the local needs of all the organizations that are to take part and the Washington office arranges reduced railway rates, manages the publication of the general program and directs the registration at the meeting.

Although most of the special scientific societies now find it necessary or desirable to meet separately or in small groups for the presentation of their contributions and for their legislative and executive proceedings, it is being increasingly appreciated that such means for the cultivation of the special sciences are not wholly adequate Scientific research now generally involves much cooperative exchange between workers in distinct fields and workers in any one of the sciences must somehow be kept acquainted with what is being done in other sciences. Furthermore, it is also becoming increasingly clear that, for the welfare of all concerned, the knowledge and wisdom of workers in science must somehow be passed along to intelligent people in general, and just as rapidly as possible. With respect to these needs the annual meetings of the American Association and Associated Societies furnish means and opportunities that can not be supplied by the more specialized meetings These great conventions promote and encourage the interchange of ideas among specialists in different lines of work and they supply one of the most valuable forms of contact between the devotees of science and the public. Such centrifugal diffusion of knowledge as is here implied is surely essential to the advance of the sciences and of science in general and to national and international welfare. From this point of view the complexity of our annual Christmas-week meetings, due to the fact that nearly all lines of serious study are represented in them, constitutes one of their greatest values They bring together science workers from remote fields and they function as a sort of annual public exposition of what science is doing and trying to do The news service at our meetings is specially important in the latter connection The opportunities here provided for personal contact and the formation and renewal of acquaintance and friendship should not be undervalued The joint sessions of several scientific groups, which are becoming more common at recent meetings, are also specially important, as are also the general sessions at which the broader aspects of scientific endeavor receive attention

A MEETING IN THE SOUTH

The annual meetings of the association are distributed, in a period of years, over approximately the eastern half of the region in which most of its members reside. Four have been held in Canada, two in Minneapolis and one in Kansas City. There have been four meetings in the South, one at Charleston, South Carolina (in March, 1850, when the organization was two years old), one at Nashville (in August, 1877), one at New Orleans (in December, 1905) and one at Atlanta (in December, 1913). Most of the annual meetings have occurred in the region roughly represented by the triangle whose angles are Chicago, New York and Washington.

The meeting now announced is to be the second Nashville meeting and the fifth to occur in the South It will be the eighty-fourth meeting of the association. While association membership is not so large in the Southern States as in other parts, yet our southern members are not behind the others in their

[1] See SCIENCE for November 25, page 493.

support of the advancement of science. It is hoped that many professional scientific workers and many friends of scientific progress and broad education, who may have been unable to attend the recent meetings of the association on account of their distance, will find it possible to be present at this Nashville meeting.

While it would not become a natural scientist in these days to attempt a long-time forecast of the weather conditions that are likely to prevail in convocation week at Nashville, yet it is safe to mention the great probability that Nashville weather at Christmas time will be pleasant and satisfactory for our meeting More emphasis may be placed on the central location of this meeting place, it is nearly central in the region over which the annual meetings have been distributed.

A large attendance is assured, and the local committee has been so efficient in making the preliminary arrangements that there is no question that all who attend will be well cared for As is shown by the following pages, the meeting promises to be very successful in every way.

The association and the societies that are to meet with it at Nashville will be the guests of Vanderbilt University, the George Peabody College for Teachers and the Ward-Belmont College for Women. The Nashville Chamber of Commerce is contributing in financial and other ways Its convention secretary, Mr. W. N. Porter, is chairman of the local committee on hotels and housing The Tennessee Academy of Science has played an important part in the preparations and the local committees have been aided by Scarritt College, the Southern Y. M C. A. Graduate School and the Nashville Public Schools We may be sure that Nashville hospitality will be unsurpassed.

LOCAL COMMITTEES AND LOCAL REPRESENTATIVES OF SECTIONS FOR THE SECOND NASHVILLE MEETING

General Chairman of Nashville Committees

W. S Leathers, M.D., professor of preventive medicine and public health, Vanderbilt Medical School.

Committee on Arrangements

John W. Barton, *chairman*; vice-president of Ward-Belmont College.

H. A. Webb, *secretary*; professor of chemistry, George Peabody College.

L. C. Glenn, professor of geology, Vanderbilt University.

G. Canby Robinson, dean and professor of medicine, Vanderbilt Medical School.

J. T. McGill, professor emeritus of organic chemistry, Vanderbilt University.

A. E. Parkins, professor of geography, George Peabody College

W. N. Porter, convention secretary of the Nashville Chamber of Commerce

J. M. Breckenridge, professor of chemistry, Vanderbilt University

G. R Mayfield, associate professor of German, Vanderbilt University

A. F. Gainer, assistant engineer, N C & St L. Railroad

A. J. Didcoct, business manager, George Peabody College

H. H. Shoulders, president of the Nashville Academy of Medicine.

E. L. Bishop, State Health Commissioner of Tennessee.

A. W. Wright, assistant professor of pathology, Vanderbilt Medical School

H C. Weber, superintendent of the Nashville Public Schools.

Committee on Finance

John W Barton, *Chairman*
Henry E Colton
Charles M McCabe

Committee on Meeting Places

A E Parkins, *Chairman*
F J Lewis
R E Baber
W H Hollinshead
W D. Strayhorn

Committee on Hotels and Housing

W N Porter, *Chairman*
Lee J. Loventhal
S C. Garrison

Committee on Exhibition

J. M Breckenridge, *Chairman*
F D Dressler
E W Goodpasture

Committee on Local Transportation

A. F. Ganier, *Chairman*
J P W Brown
W. F. Pond

Committee on Publicity and Non-technical Lectures

G R. Mayfield, *Chairman*
H. A. Webb
T. J. Norner
T. H. Alexander
J. S Stahlman, Jr.

Committee on Entertainment

A. W. Wright, *Chairman*
C. P. Connell
Mrs. A. B. Benedict

W W Carpenter
Alf Williams

Each section of the association has, as usual, a local representative to look after the needs of the organizations that are related to the section. A list of the names of the local representatives is given below

Representatives for Sections

Section A (Mathematics), C M Sarratt
Section B (Physics), C R Fountain
Section C (Chemistry), L J Bircher
Section D (Astronomy), James McClure
Section E (Geology and Geography), L. C Glenn
Section F (Zoological Sciences), E E Reinke
Section G (Botanical Sciences), J M. Shaver
Section H (Anthropology), W D Weatherford
Section I (Psychology), Joseph Peterson.
Section K (Social and Economic Sciences), C B Duncan
Section L (Historical and Philological Sciences), H C Sanborn
Section M (Engineering), W H Schuerman
Section N (Medical Sciences), P D Lamson
Section O (Agriculture), K C Davis.
Section Q (Education), S J Phelps.
For organizations not related to any particular section, C P Connell.

OFFICERS OF THE ASSOCIATION FOR THE CALENDAR YEAR 1927, INCLUDING THE SECOND NASHVILLE MEETING

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Arthur A. Noyes, California Institute of Technology, Pasadena, Calif

RETIRING PRESIDENT

L H Bailey, 103 Sage Place, Ithaca, N Y

VICE-PRESIDENTS, RETIRING VICE-PRESIDENTS AND SECRETARIES OF THE SECTIONS

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Vice President, Dunham Jackson, University of Minnesota, Minneapolis, Minn

Retiring Vice President, Edward V. Huntington, Harvard University, Cambridge, Mass.

Secretary, R C Archibald, Brown University, Providence, R I

Section B (Physics)

Vice President, A H Compton, University of Chicago, Chicago, Ill

Retiring Vice President, William Duane, Bio Physical Laboratories, Harvard University, 695 Huntington Ave, Boston, Mass.

Secretary, A. L. Hughes, Washington University, St Louis, Mo

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Retiring Vice-President, Lauder W. Jones, Princeton University, Princeton, N. J

Secretary, Gerhard Dietrichson, Massachusetts Institute of Technology, Cambridge, Mass.

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Retiring Vice-President, Robert G Aitken, Lick Observatory, Mt Hamilton, Calif

Secretary, Philip Fox, Dearborn Observatory, Northwestern University, Evanston, Ill

Section E (Geology and Geography)

Vice-President, Charles Schuchert, Yale University, New Haven, Conn

Retiring Vice-President, G H. Ashley, State Capitol, Harrisburg, Pa.

Secretary, G R. Mansfield, U S Geological Survey, Washington, D C

Section F (Zoological Sciences)

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Retiring Vice-President, Winterton C Curtis, University of Missouri, Columbia, Mo.

Secretary, Geo. T Hargitt, Syracuse University, Syracuse, N Y

Section G (Botanical Sciences)

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Secretary, Fay Cooper Cole, University of Chicago, Chicago, Ill

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Vice-President, Knight Dunlap, Johns Hopkins University, Baltimore, Md.

Retiring Vice-President, Margaret Floy Washburn, Vassar College, Poughkeepsie, N. Y.

Secretary, Frank N Freeman, University of Chicago, Chicago, Ill

Section K (Social and Economic Sciences).

Vice President, W S Leathers, Vanderbilt University, Nashville, Tenn.

Retiring Vice-President, Joseph H Willits, University of Pennsylvania, Philadelphia, Pa.

(No secretary has been elected since the resignation of Doctor F. L Hoffman last year, and no program for Section K has been arranged for the Nashville meeting.)

Section L (Historical and Philological Sciences):

Vice-President, Harry Elmer Barnes, Smith College, Northampton, Mass.

Retiring Vice-President, W. Carl Rufus, University of Michigan, Ann Arbor, Mich.

Secretary, Frederick E. Brasch, Library of Congress, Washington, D. C.

Section M (Engineering):

Vice-President, A. N. Talbot, University of Illinois, Urbana, Ill.

Retiring Vice President, C R. Richards, Lehigh University, Bethlehem, Pa.

Secretary, N H Heck, U S Coast and Geodetic Survey, Washington, D C

Section N (Medical Sciences)

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Retiring Vice-President, Rufus I Cole, Rockefeller Hospital, New York, N Y

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Retiring Vice President, C F Marbut, U S Bureau of Soils, Washington, D C

Secretary, P E Brown, Iowa State College, Ames, Iowa

Section Q (Education):

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Retiring Vice-President, Melvin E Haggerty, University of Minnesota, Minneapolis, Minn.

Secretary, A. S Barr, University of Wisconsin, Madison, Wis.

PERMANENT SECRETARY

Burton E Livingston, Johns Hopkins University, Baltimore, Md. (Association mail address. Smithsonian Institution Building, Washington, D C)

GENERAL SECRETARY

W J Humphreys, U S Weather Bureau, Washington, D C

TREASURER

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MANAGER OF EXHIBITION

H. S. Kimberly, Smithsonian Institution Building, Washington, D. C.

MEMBERS OF THE EXECUTIVE COMMITTEE OF THE COUNCIL*

J. McKeen Cattell (1930), *chairman*, Garrison-on-Hudson, N. Y.

A. A. Noyes, president of the association (1927), California Institute of Technology, Pasadena, Calif.

Burton E. Livingston, permanent secretary (1928), Smithsonian Institution Building, Washington, D C

W J Humphreys, general secretary (1928), U S Weather Bureau, Washington, D C

Herman L. Fairchild (1927), University of Rochester, Rochester, N Y

Vernon Kellogg (1928), National Research Council, Washington, D C

F R. Moulton (1929), University of Chicago, Chicago, Ill.

W A. Noyes (1927), University of Illinois, Urbana, Ill

M I Pupin (1929), Columbia University, New York, N Y

Henry B Ward (1930), University of Illinois, Urbana, Ill

Edwin B Wilson (1928), Harvard School of Public Health, Boston, Mass

* The number in parentheses denotes the year at the end of which the member's term of office is to expire.

MEMBERS OF THE COMMITTEE ON GRANTS FOR RESEARCH*

Aleš Hrdlička (1927) (for Psychology, Anthropology, Education, Economics), *chairman*, U S National Museum, Washington, D C

B M. Davis (1927) (for Botany), University of Michigan, Ann Arbor, Mich.

Nevin M Fenneman (1928) (for Geology), University of Cincinnati, Cincinnati, Ohio

Joseph Erlanger (1928) (for Physiology), Washington University School of Medicine, St. Louis, Mo

L. G Hoxton (1929) (for Physics), University of Virginia, University, Va.

Vernon Kellogg (1929) (for Zoology), National Research Council, Washington, D C

W Lash Miller (1930) (for Chemistry), 8 Hawthorne Ave, Toronto, Ont, Canada.

Oswald Veblen (1930) (for Mathematics), Princeton University, Princeton, N J

(The permanent secretary acts as secretary of the Committee on Grants.)

GENERAL OFFICERS OF THE COMMITTEE OF ONE HUNDRED ON SCIENTIFIC RESEARCH

Chairman, A A Noyes, president of the Association, California Institute of Technology, Pasadena, Calif

Secretary, Rodney H True, University of Pennsylvania, Philadelphia, Pa

ASSOCIATED AND INVITED ORGANIZATIONS THAT ARE PLANNING SCIENTIFIC SESSIONS FOR THE NASHVILLE MEETING

THE following is a list of the organizations that have intimated their intention to take part in the annual meeting this year, together with the names and addresses of their respective secretaries and (as far as

* The number in parentheses denotes the year at the end of which the member's term of office is to expire.

possible) the names of their respective hotel headquarters for the meeting.

American Mathematical Society. R. G D Richardson, *Secretary*, Brown University, Providence, R I.—*Hotel headquarters, Ward-Belmont College Dormitories*

Mathematical Association of America W D Cairns, *Secretary*, Oberlin College, Oberlin, Ohio.—*Hotel headquarters, Ward-Belmont College Dormitories*

American Physical Society· Harold W. Webb, *Secretary*, Columbia University, New York, N Y—*Hotel headquarters, Ward-Belmont College Dormitories*

American Meteorological Society. Charles F Brooks, *Secretary;* Clark University, Worcester, Mass—*Hotel headquarters, Hermitage Hotel, Union St and Sixth Ave*

Association of American Geographers. Charles C Colby, *Secretary*, University of Chicago, Chicago, Ill—*Hotel headquarters, Maxwell House, Church St and Fourth Ave*

National Council of Geography Teachers George J Miller, *Secretary;* State Teachers College, Mankato, Minn—*Hotel headquarters, George Peabody College Dormitories.*

American Society of Zoologists Dwight E Minnich, *Secretary*, University of Minnesota, Minneapolis, Minn.—*Hotel headquarters, Hermitage Hotel, Union St and Sixth Ave*

Entomological Society of America· J J Davis, *Secretary*, Purdue University, Lafayette, Ind.—*Hotel headquarters, Hermitage Hotel, Union St and Sixth Ave.*

American Association of Economic Entomologists C W Collins, *Secretary;* Melrose Highlands, Mass.—*Hotel headquarters, Hermitage Hotel, Union St. and Sixth Ave*

American Society of Parasitologists. W W Cort, *Secretary*, 615 N Wolfe St, Baltimore, Md.—*Hotel headquarters, Hermitage Hotel, Union St and Sixth Ave.*

Wilson Ornithological Club. Howard K Gloyd, *Secretary;* Kansas State Agricultural College, Manhattan, Kans—*Hotel headquarters, Hermitage Hotel, Union St. and Sixth Ave*

Botanical Society of America: A. J Eames, *Secretary;* New York State College of Agriculture, Ithaca, N Y.—*Hotel headquarters, Sam Davis Hotel, Commerce St and Seventh Ave*

American Phytopathological Society· R J Haskell, *Secretary;* Bureau of Plant Industry, Washington, D. C—*Hotel headquarters, Sam Davis Hotel, Commerce St and Seventh Ave*

American Society of Plant Physiologists. Scott V Eaton, *Secretary;* University of Chicago, Chicago, Ill—*Hotel headquarters, Sam Davis Hotel, Commerce St and Seventh Ave.*

American Society of Naturalists L. J Cole, *Secretary;* College of Agriculture, Madison, Wis—*Hotel headquarters, Hermitage Hotel, Union St and Sixth Ave.*

Ecological Society of America: A. O. Weese, *Secretary;* University of Oklahoma, Norman, Okla.—*Hotel headquarters, Sam Davis Hotel, Commerce St. and Seventh Ave.*

American Microscopical Society: H J. Van Cleave, *Secretary*, University of Illinois, Urbana, Ill—*Hotel headquarters, Hermitage Hotel, Union St. and Sixth Ave*

Southern Society for Philosophy and Psychology J. A. Highsmith, *Secretary;* College for Women, Greensboro, N. Carolina.—*Hotel headquarters, Tulane Hotel,* Church St and Eighth Ave

Metric Association. Howard Richards, *Secretary;* 156 Fifth Ave., New York, N. Y.—*Hotel headquarters, Ward-Belmont College Dormitories*

Linguistic Society of America Roland G. Kent, *Secretary;* University of Pennsylvania, Philadelphia, Pa.—*Hotel headquarters, Hermitage Hotel, Union St. and Sixth Ave.*

American Society for Horticultural Science. C P Close, *Secretary;* College Park, Md—*Hotel headquarters, Tulane Hotel, Church St. and Eighth Ave.*

Potato Association of America· Walter M. Peacock, *Secretary;* Office of Horticultural Investigations, Washington, D. C—*Hotel headquarters, Tulane Hotel, Church St. and Eighth Ave*

American Nature-Study Society: E Laurence Palmer, *Secretary*, State College of Agriculture, Ithaca, N. Y—*Hotel headquarters, Tulane Hotel, Church St and Eighth Ave.*

Society of the Sigma Xi· Edward Ellery, *Secretary;* Union College, Schenectady, N Y—*Hotel headquarters, Andrew Jackson Hotel, Deadrick St. and Sixth Ave.*

Tennessee Academy of Science· J. T McGill, *Secretary*, Vanderbilt University, Nashville, Tenn.

NEWS SERVICE AT THE NASHVILLE MEETING

The object of the association news service is to inform the general public through the press regarding the work that is being done in American science as illustrated by the papers presented at the annual meetings. The news service is in charge of Austin H. Clark, of the U. S. National Museum, who was chairman of the publicity committees at the recent Washington and Philadelphia meetings. Mr. Clark is the manager of news for the American Association. The local committee on publicity, whose chairman is Professor G. R. Mayfield, has given very valuable help in this important phase of the preparations for the meeting. The association news service will again have the cooperation of Science Service, which will furnish news of the meeting to a series of dailies that have already arranged for this. It will be remembered that Science Service has offices in the National Academy Building, Washington, D C., that it was organized to supply reliable science news to daily papers, that it is the publisher of the *Science News-Letter*, and

that the American Association is officially represented by three members on its board of directors. In addition, several other news organizations and a number of the great dailies will have representatives at the Nashville meeting.

The press representatives will be freely supplied with just as full and just as usable information as is possible, and much of it will be ready for use long before the date of release. This can be accomplished only in so far as those who are planning to give papers or deliver addresses at the meeting will send their manuscripts, accompanied by abstracts (preferably of about 500 words), or at least abstracts, to the news manager well in advance of the opening of the meeting.

The abstracts should be written in the simplest possible language, so that they may easily be understood by any one with a good education but with no knowledge of the details of the subject treated. Especially should the broader aspects of the work be indicated and the bearing which it has or may have on work in other lines. These manuscripts should each show the name of the organization before which the paper is to be presented, with information as to the date of presentation, as nearly as the latter can be given, at the top of the manuscript write, "Paper to be presented before the ———— (name) Society at its session on ———— (date)." Manuscripts for the news service should be sent to Mr. Clark, at the Washington office of the association, in the Smithsonian Institution Building. It needs to be emphasized that the efficiency of our news service will depend on the early sending of manuscripts by the authors, the material must be worked over and prepared for use by the representatives of the press and the greater part of this work must be done in Washington, before the meeting opens. The same applies to the working over of manuscripts by the staff of Science Service. *Prepare manuscripts in triplicate and send one copy to Mr. Clark, a second to Science Service and a third to the secretary of the society or section concerned.*

It is hoped that the material prepared by our news service may be made freely available to the press representatives, at least a week before the day of presentation of the paper in each case, marked for release only at the proper time. The daily press is now the strongest ally of the association, in its efforts to cultivate and extend an appreciation of science and research among intelligent people. The news service will try to bring authors of important papers into touch with the press representatives, for interviews, and the men and women of science who will be present at the Nashville meeting are asked to do all they can to facilitate the work of the newspaper men. Those who have news material are asked to cooperate with Mr. Clark, to the end that the news of the meeting may be consistently and efficiently released, and all press representatives and organizations are asked to cooperate in the same way.

THE NASHVILLE PRIZE

The fifth annual award of the American Association Prize, of one thousand dollars, will occur at the close of the Nashville meeting. A generous member of the association, who does not wish his name made known, has given the funds for the four prizes that have already been awarded and additional funds for five more prizes, including the one to be awarded this year. It is expected that the annual award will be continued indefinitely. The prize is awarded each year to the author of a notable contribution* to science presented at the annual meeting. All papers presented in any of the programs of the Nashville meeting are to be eligible for consideration by the Committee on Award, it is not necessary that the author be a member of the association. There is to be no open competition and no submitting of papers for the prize. The rules and procedure by which the award is to be made have been published in SCIENCE for November 25. The award will be announced at the close of the meeting, through the news office.

TRANSPORTATION TO AND FROM NASHVILLE

Reduced railway rates, by the certificate plan, have been granted for this meeting by the railway passenger associations of the United States and Eastern Canada, whose courtesy and public spirit will be greatly appreciated. The round-trip fare for a person attending the meeting is to be one and one half times the regular one-way fare.

Tickets to Nashville are to be purchased within time limits as follows: December 22 to 28, inclusive, for the following lines: Canadian Eastern lines, New England lines, Trunk lines, Central lines and Southeastern lines. For the Western and Transcontinental lines the limits are December 16 to 22, inclusive, from Arizona, British Columbia, California, Idaho, Nevada, Oregon and Washington; December 20 to 26, inclusive, from Utah, December 21 to 27, inclusive, from Colorado (except Julesburg), Montana, New Mexico and Wyoming; December 22 to 28, inclusive, from Colorado (Julesburg only), Illinois, Iowa, Kansas, Mani-

* It may sometimes be the *most* notable contribution presented, but there is obviously no way by which important contributions in different scientific fields may be satisfactorily compared as to their several degrees of goodness. The wording in the text is strictly accurate and official and such superlatives as "best" and "most noteworthy" are not to be applied under any circumstances.—B. E. L.

toba (on the Great Northern, the Northern Pacific and the Milwaukee, St. Paul and Sault Ste Marie railways, also from Winnipeg *via* the Canadian National and Canadian Pacific railways), Minnesota, Missouri, Nebraska, Northern Michigan, North Dakota, South Dakota and Wisconsin For the Southwestern lines the limits are December 21 to 27, inclusive, from Oklahoma and Texas, December 22 to 28, inclusive, from Kansas, Missouri, Arkansas and Louisiana. The following Southwestern lines do not offer the reduced excursion fares (1) Arkansas & Louisiana-Missouri Ry, (2) Fort Smith & Western R R, (3) Graysonia, Nashville & Ashdown R R, (4) Kansas, Oklahoma & Gulf Ry, (5) Louisiana and Arkansas Ry, (6) Mississippi River and Bonne Terre Ry and (7) National Railways of Mexico

Persons residing in the regions of reduced rates (almost all the United States and Canada, see above) should each purchase a first-class, full-fare, one-way, through ticket to Nashville, and be sure to secure a certificate on the "Standard Certificate Form," reading for the Nashville meeting of the "American Association for the Advancement of Science and Associated Societies"; a receipt is not required

Persons residing outside the regions of reduced rates should each purchase a round-trip ticket to the nearest station issuing through tickets to Nashville and lying within the region of reduced rates On arrival at that station each person should purchase a one-way ticket to Nashville and secure a certificate, as directed in the preceding paragraph.

Upon arrival at the meeting, each person should register immediately, at the registration offices in the Andrew Jackson Hotel Be sure to fill in all blanks on the registration card and leave the card at the registration desk, where you will receive a numbered identification card, which will be receipted for the registration fee if you pay it (See Registration, below.) Then leave your railway certificate at the validation desk, being sure that the identification card (which you keep) is there marked to show that you have deposited a certificate Your certificate will subsequently be endorsed by the association and then validated by the agent of the transportation companies Call for it later at the validation desk, presenting your identification card

Unvalidated certificates will not be honored for the purchase of return tickets, and unendorsed certificates can not be validated. Registration is, therefore, necessary in order to have a railway certificate validated Each person registering is entitled to the validation of his own certificate

For the return trip, railway ticket agents at Nashville will honor any properly endorsed and validated certificate if presented at least 30 minutes before the scheduled time of departure of the train for which it is to be used To each person presenting an endorsed and validated certificate they will sell a continuous passage, one-way, return ticket for one half of the regular fare, by the same route as that followed on the trip to Nashville The last date on which certificates may be validated is December 31 The last date on which return tickets may be purchased is January 4

TRANSPORTATION IN NASHVILLE

For this meeting the distances are short between the hotel region and the meeting places and between the Union Depot and either the hotel district or the meeting places The hotel district is about two miles from the university and college buildings, in which the scientific sessions are to be held, and the Union Depot (Louisville and Nashville R R and Nashville, Chattanooga and St Louis Ry) is between the hotel district and the campuses, about six or eight city blocks from the hotels From the Union Depot one takes street cars on Broadway, west bound (marked "Hillsboro") for the campuses and east bound for the hotels There are buses as well as street cars. To reach the Union Depot or the campuses from the hotels, take cars marked "Hillsboro," which may be boarded at Fourth Avenue and Church Street (for those lodging in Maxwell House), at Sixth Avenue and Church Street (for those lodging in Andrew Jackson Hotel or Hermitage Hotel), at Seventh Avenue and Church Street (for those lodging in Sam Davis Hotel, Y M C A or Y W C A.), or at Eighth Avenue and Church Street (for those lodging in Tulane Hotel) The dormitory buildings are only a few minutes' walk from any of the session rooms

Special transportation between the hotels and the campuses is being planned for the meeting Further information and charts of the college grounds and the hotel district are to be included in the General Program.

LODGING ACCOMMODATIONS

The lodging accommodations for those who attend the second Nashville meeting are to be mainly in the hotels and dormitories named in the accompanying table. Special symbols in the table have these meanings: TB, two single beds; DB, double bed; TDB, two double beds (to accommodate four persons); an asterisk denotes that rooms without bath are provided with running water The general headquarters is to be the Andrew Jackson Hotel, on the lower floor of which will be located the registration and news offices and the science exhibition Headquarters for those in the several fields of science are to be as follows:

Andrew Jackson Hotel (general headquarters): Engineering, Medical Sciences, Education.

Hermitage Hotel: Zoology, Entomology, Microscopy, Genetics, Parasitology, Ornithology, Meteorology, Linguistic Science, History.

Maxwell House Geology, Geography (See, also, Peabody Dormitories, below)

Tulane Hotel Horticulture, Nature Study, Anthropology, Psychology, Philosophy

Sam Davis Hotel Chemistry, Botany, Phytopathology, Ecology

Ward-Belmont College for Women, Dormitories Mathematics, Physics, Astronomy

George Peabody College for Teachers, Dormitories Geography Teaching.

tions in these institutions. Their prices, as well as those of smaller hotels in the central district and a number of uptown apartment hotels, which will be available if needed, are to be from $1 25 to $3 per day per person In case of need additional rooms will be available in fraternity and sorority houses and other dormitories connected with the colleges, at $2 per day per person There will be no insufficiency of lodging accommodations, but early reservations are highly desirable, to avoid possible disappointment as to location and price Every one planning to attend the Nashville meeting should make reservation now

LODGING ACCOMMODATIONS AT NASHVILLE

Hotel or Dormitory	Location	Number of Rooms	Telephone No	Prices, per day Without Bath 1 person	Without Bath 2 persons	With Bath 1 person	With Bath 2 persons
Andrew Jackson	Deadrick St and 6th Ave.	400	6–6101			$2 50–$5	$4 00–$6 DB $5 00–$7 TB
Hermitage	Union St and 6th Ave	250	6–2161			$2 50–$5	$4 00–$7 TB
Sam Davis	Commerce St. and 7th Ave	250				$2 50	$4 00 DB $5 00 TB
Tulane	Church St. and 8th Ave	200	6–1601	$1 50	$3 00 TB $2 50 DB	$2 00 $3 00	$4 00 DB $5 00 TB
Maxwell	Church St and 4th Ave	200	6–1131	$1.50	$2.50 TB $3 00 TB	$2 00 $3 00	$3 50–$4 DB $5 00 TDB
Savoy	7th Ave, near Church St.	75	6–2681	$1 50	$2 50 DB $3 00 TB	$2 00 $3 00	$3.50–$4 DB $5 00 TB
Ward-Belmont Dormitories	Belmont Heights	500	7–3100	$2 per day per person (Some with twin beds, some single)			
Peabody Dormitories	21st Ave	300	7–3600	$2 per day per person (Some with twin beds, some single)			

The hotels are about two miles from the meeting places on the college and university campuses. The meeting places are close together and only a few minutes' walk from the Ward-Belmont and Peabody dormitories. Transportation is by regular street cars and buses, but special transportation for the meeting is being planned, which will make the trip between hotels and campuses in about fifteen minutes or less

Hotel reservations should be made by writing directly to the hotel concerned, statement being made as to kind of accommodations desired, date of arrival and approximate price Those who desire the lower-priced rooms should send in their requests early Many reservations have already been made For rooms in dormitories, which are close to the meeting places, requests for reservations should be addressed to the Ward-Belmont College or the Peabody College The Nashville Y. M. C. A., Y. W. C. A, Y. M. H. A. and Y. W. H. A. are in the hotel district of the city and are to be addressed directly by those desiring reserva-

REGISTRATION AT THE NASHVILLE MEETING

The Registration Offices for the meeting will be in the main lobby of the Andrew Jackson Hotel, Sixth Ave and Deadrick St. They are to be in charge of Mr Sam Woodley, executive assistant of the American Association, and will be open from 9 to 6 daily, throughout the period of the meeting. Registration is necessary in order to secure the official identification card, the official badge, the general program, etc, and in order that railway certificates may be endorsed and validated All who attend any of the sessions should register as promptly as possible, whether they are members of the association or not

A Registration Fee of one dollar is to be paid by each person registering for this meeting, excepting such visitors from the outside of the United States as may be personally invited to be the guests of the association. The moneys thus collected will go into the

fund for the meeting and will help defray some of the costs. But, if you are a paid-up member of the American Association for the Advancement of Science or if you are an associate for this meeting, the registration fee may be remitted to you; that is, you may register without paying the fee *Paid-up members should bring with them to Nashville their blue membership cards for 1927–28* Registrants who are not paid-up members of the association or associates may place themselves in the privileged category by paying their dues before registering Personally invited guests are not to pay the fee. Instructions regarding procedure for those not paying the registration fee will appear on the reverse of the registration card. The card is to be filled out whether the fee is to be paid or not.

Registration will be Accomplished as Follows. Fill in the blanks on a registration card, which will be furnished in the registration room, and present the card at the cashier's desk, paying the registration fee if required The registration card will be stamped to show whether the fee is paid or not. Then present the registration card to the registration clerk, who will keep it and will give you a numbered official identification card, together with the badge for the meeting, a copy of the General Program, etc The identification card will be specially stamped if the registration fee has been paid and your name will be placed immediately in the visible directory of those in attendance. After registration you should leave your railway certificate at the validation desk, where your identification card will be marked to show that a certificate has been left (See above, under Transportation to and from Nashville)

Delegates from institutions and organizations, and all personally invited guests, are specially requested to register as such, noting on their registration cards their exact status in this particular

Visitors from outside of the United States and Canada who are not members of the association may be invited to the meeting as guests of the association. Members of the association should make recommendations as to visitors who should receive official invitations, giving reasons. Such recommendations should be in the permanent secretary's office in Washington by December 20 at latest.

SPECIAL PRIVILEGE FOR MEMBERS OF AFFILIATED SOCIETIES

New members of the association regularly pay an entrance fee of five dollars, which is now remitted, however, to members of any affiliated organization, including the affiliated state academies. Those who join at the Nashville meeting and take advantage of this privilege should fill in the blanks on a blue membership application card and present card and dues for 1927–28 ($5.00) at the membership-dues desk in the registration offices in the Andrew Jackson Hotel. New members who join the association at the meeting are entitled to register without paying the one-dollar registration fee

Copies of a booklet on "The Organization and Work of the American Association," as well as membership application cards and sample copies of the journals, may be secured at any time from the permanent secretary's Washington office in the Smithsonian Institution Building Membership in the association includes a subscription to the weekly journal SCIENCE, or *The Scientific Monthly*, for the calendar year beginning at the close of the annual meeting. The journal alone is worth more than the annual membership dues. By special arrangement with the publishers, members in good standing may have both SCIENCE and *The Scientific Monthly* by paying $3 00 in addition to the annual dues ($8.00 in all) Members of the association may also subscribe for *The Science News-Letter*, published by Science Service, Washington, D C, at the specially reduced price of $3 00 per year.

INFORMATION SERVICE, MAIL, EXPRESS, TELEGRAMS, ETC, AT THE NASHVILLE MEETING

Those in attendance at the meeting may obtain information of all sorts by applying at the Information desk in the registration offices, in the Andrew Jackson Hotel Attention is called, however, to the visible directory of those in attendance, from which information regarding attendance and the addresses of attending members of the association and societies may be obtained without application at the desk.

Persons attending the meeting may have mail, etc., addressed to them in care of the American Association for the Advancement of Science, Registration Offices, Andrew Jackson Hotel, Nashville, Tenn. They should inspect the personal bulletin every day, which will be conveniently located. If a person's name appears on this bulletin, he should inquire at the proper desk for mail, etc. Uncalled for telegrams will be sent to hotels or dormitories each afternoon when the registration offices close.

BUSINESS SESSIONS OF THE ASSOCIATION AT NASHVILLE

The members of the executive committee of the association council, the secretaries of the association sections and the secretaries of the scientific societies that meet with the association this year will dine together on Friday, December 30, at 6:30 at the Andrew Jackson Hotel. The dinner will be complimentary, from the American Association. The evening will

be devoted to the annual secretaries' conference on the affairs of the association and its relation to the associated organizations.

The executive committee will hold its first Nashville session in the permanent secretary's room at the Andrew Jackson Hotel, on Monday, December 26, at 10 o'clock. Matters for consideration on Monday by the committee or by the council should be transmitted to the Washington office, to arrive by December 20 Other sessions of the executive committee will be held at 10 o'clock on Tuesday, Wednesday, Thursday and Friday mornings, in Room 101, Industrial Arts Building, George Peabody College for Teachers.

The council of the association will meet in the Andrew Jackson Hotel on Monday afternoon, December 26, at 2 o'clock Other sessions are scheduled to occur at 9 o'clock on Tuesday, Wednesday, Thursday and Friday mornings, in the council room, Room 101, Industrial Arts Building, George Peabody College for Teachers. It is probable that the annual election of officers of the association will occur at the council session Thursday morning. Business to be considered by the council must regularly be first brought before the executive committee through the permanent secretary. Communications for the permanent secretary should be addressed to the Washington office (to arrive by December 20) or to the Andrew Jackson Hotel (to arrive December 26). During the meeting they may be handed in to Mr. Woodley in the registration offices, at the same hotel

Immediately following the council session on Monday afternoon, an academy conference will be held by the association's special committee on academy relations. This committee consists of the representatives of the affiliated state academies (one from each affiliated academy), together with all members of the committee on interacademy relations that was appointed by the academy conference at Philadelphia, and three members representing the executive committee of the association. The members of the special committee will dine together following the conference, at the association's complimentary academy dinner, at 6.30, at the Andrew Jackson Hotel. The dinner will be over in time for the opening session of the Nashville meeting A special session of the Tennessee Academy of Science is announced for Monday morning at 10, to welcome visiting members of other state academies.

THE SCIENCE EXHIBITION

The annual exhibition of scientific apparatus, materials, methods, books, etc., will be in the Andrew Jackson Hotel, adjacent to the registration offices. Nearly all the available space has been engaged by the exhibiting firms, but some attractive exhibits of a purely scientific nature will be included. The exhibition has become a very important part of the annual meeting. Its popularity steadily increases from year to year, both with the exhibiting firms and with those who attend the meeting. It furnishes a ready means by which those who purchase laboratory apparatus and supplies and scientific books may examine the products of the best makers and publishers. It also makes it possible for research workers to become acquainted with new models of apparatus, new methods and new publications in their own and other fields The exhibition has become a sort of social center, also, a place where friends and acquaintances may meet and spend many agreeable and profitable periods during the week of the meeting Such exhibitions are very effective in promoting the personal exchange of ideas, not only among scientists in the same field but between workers in widely different sciences.

As in recent years, the Nashville exhibition will be in charge of Major H S Kimberly, exhibition manager It is under the general direction of the exhibition committee, of which H. E. Howe, editor of the *Journal of Industrial and Engineering Chemistry*, is chairman Major Kimberly has had valuable help from the local committee on exhibition, of which Dr. J M. Breckenridge, professor of chemistry in Vanderbilt University, is chairman.

GENERAL SESSIONS OF THE ASSOCIATION

The second Nashville meeting will be held under the presidency of Dr. A. A. Noyes, eminent chemical investigator and leader in chemical education, professor of chemistry and director of the Gates Chemical Laboratory of the California Institute of Technology.

The general sessions at the annual meetings of the association are planned to be of interest to all workers in science and to educated people generally. They are the only sessions held by the association as a whole. The following notes give information about the general sessions that are planned for the Nashville meeting, as far as statements can be made at the time this preliminary announcement goes to press. Times of occurrence may require alteration.

The opening session will occur on the evening of Monday, December 26, in the auditorium of the Nashville War Memorial Building, at 8 o'clock. The main speaker of the evening is to be Dr. L. H. Bailey, well-known student of systematic botany, author and editor of our most valuable reference books on cultivated plants and many books on nature and rural life. Dr. Bailey was president of the association

last year. He is to deliver at Nashville the address of the retiring president, on "The Biologies."

Following the opening session will occur the general reception to those who attend this meeting, by the local committees and other local representatives. Refreshments will be served. The reception is to be in the Andrew Jackson Hotel, Deadrick St and Sixth Ave

On Tuesday evening, December 27, in the auditorium of the War Memorial Building, the sixth annual Sigma Xi lecture will be given This lecture is provided by the Society of the Sigma Xi and regularly occurs on the second evening of the annual meeting of the association. The lecturer this year is Dr Clarence Cook Little, president of the University of Michigan, eminent student of genetics, especially in relation to susceptibility to cancer. He will speak on "Opportunities for research in mammalian genetics"

Wednesday, December 28, will be characterized by two general sessions bearing on the diffusion of scientific knowledge, "Science for the People" A morning and an afternoon program are being arranged by Austin H. Clark, of the U. S National Museum, science-news manager of the association

Wednesday afternoon at 4 30 is to be given the fifth annual Josiah Willard Gibbs Lecture, under the joint auspices of the American Mathematical Society and the American Association. This lecture is arranged by the American Mathematical Society The lecturer this year is Professor Ernest W Brown, of Yale University, eminent mathematician and astronomer. Dr Brown's subject is "Resonance in the solar system"

The retiring vice-presidential address for Section D (Astronomy) is to be given at the general session on Wednesday evening, by Dr Robert G. Aitken, of the Lick Observatory, Mount Hamilton, California, well known for his researches on binary stars and in other fields of astronomy. He will speak on the life and work of Edward Emerson Barnard. That noted astronomer was born in Nashville in 1857, and was graduated from Vanderbilt University in 1886. He made many valuable contributions to astronomy, among which may be mentioned the discovery of the fifth satellite of Jupiter It is specially fitting that a general session at this Nashville meeting should be devoted to his memory

A general session on the afternoon of Thursday, December 29, is to be devoted to a series of papers by well-known investigators, on some phases of the economic relations of science workers. This program has been developed by the Committee on the Economic Status of College and University Workers, a subcommittee of the association's Committee of One Hundred on Scientific Research, of which Dr. Rodney H. True, of the department of botany of the University of Pennsylvania, is secretary The opening address is to be by Dr A A Noyes, president of the American Association Mr. Harrison E Howe, editor of *Industrial and Engineering Chemistry*, will speak on "The relation of research to wealth increase" "Comparative salary scales of trained men" is the subject of a paper to be presented by Dr Rodney H True, secretary of the Committee of One Hundred Professor Jessica B Peixotto, of the department of social science, University of California, author of "Getting and spending at the standard of professional living," will discuss "Family budgets of university faculty members" Discussions of these papers will follow by well-known scientists This session should prove to be of great interest to all who attend the Nashville meeting

Another general session, on "Aquiculture," is being planned for Thursday afternoon, at 2 30 A program of invited papers is being arranged by Professor Robert E. Coker, of the University of North Carolina, for the Committee on Aquiculture, a committee organized at the request of the National Research Council. The committee invites the counsel and cooperation of those interested in hydrobiological research or in the practical development of aquiculture It is hoped that botanists, zoologists, geologists, chemists, meteorologists, engineers, economists and others may cooperate to promote the utilization of water areas for the culture of fishes, water birds, crustacea, pearl mussels, fur-bearing mammals, aquatic and swamp plants, etc. Some of the most fundamental problems of biology are involved in this project

The general session Thursday evening is to be devoted to a lecture on "Science and the Newspapers," by Dr. William E. Ritter, well-known research worker and leader in zoology and writer on philosophical aspects of biology Dr. Ritter was the organizer and for many years the director of the Scripps Institution of Oceanographic Research, at La Jolla, California. He has been a leader in the organization and guidance of the popular Science Service, of Washington, D. C., which was endowed by the late E W. Scripps for the purpose of supplying science news to the daily press. This general session will continue and round out the Wednesday symposium on "Science for the People." The following note on his address has been received from Dr. Ritter.

Science and journalism are both very powerful influences in modern civilization, but they have developed independently in large measure and they are sometimes more or less antagonistic. A study of the work of such men as Benjamin Franklin and Thomas Jefferson, who combined scientific research with ardent support of the

newspapers and who mightily influenced our material development, leads to the thought that closer cooperation is needed between the scientists and the journalists

NON TECHNICAL LECTURES AT NASHVILLE

Recognizing that the truths of science, the scientific method of thought and the principles and standards of scientific scholarship need to be presented at every opportunity to the general public and especially to adolescents, the American Association generally provides a number of non-technical lectures and demonstrations at the annual meetings. A series of such lectures is being arranged for the people of Nashville, some of them especially for students in the schools These will be announced later Speakers will be provided for several luncheon-meetings of local organizations.

A TRIP TO THE GREAT SMOKY MOUNTAINS

Those who attend the Nashville meeting are invited to visit the Great Smoky Mountains after the close of the meeting Those who take advantage of this invitation will be provided with transportation and entertainment for the trip from Knoxville to the mountains and return, as guests of the Chamber of Commerce of Knoxville, Tenn A national park is being established in the Great Smokies, which are exceptionally rich and varied in both flora and fauna. Many peaks rise to elevations of over 6,000 feet above sea level and the region presents many interesting geological features, stratigraphic, structural and physiographic.

This invitation to visit the Great Smoky Mountains is from the Tennessee Academy of Science, the University of Tennessee, Vanderbilt University, the Great Smoky Mountains Conservation Association, the Smoky Mountains Hiking Club and the Knoxville Chamber of Commerce. Correspondence concerning the trip may be addressed to Professor L. R. Hesler, Botany Department, University of Tennessee, Knoxville, Tenn. During the meeting information in this connection may be had in the registration offices, in the Andrew Jackson Hotel.

SESSIONS OF THE SECTIONS AND SOCIETIES

Nearly all branches of science will be well represented in the many scientific sessions of the sections and associated societies at Nashville. Preliminary notes on the programs that are being arranged for these sessions are given below The information has been contributed by the section and society secretaries, for whose cooperation in the preparation of this section of our announcements the permanent secretary is deeply grateful. Full information about the scientific sessions will be given in the General Program of the meeting, which will be available Monday morning, December 26, at the registration offices, in the Andrew Jackson Hotel, at Nashville. A copy of the book will be mailed free to any member in good standing whose request for it is received before December 22 at the Washington office of the association

The following accounts are arranged under headings that correspond to the sections of the American Association.

A Mathematics—The American Mathematical Society and the Mathematical Association of America will meet jointly with Section A of the American Association for the Advancement of Science on Thursday afternoon, December 29 Professor E. V Huntington, of Harvard University, retiring vice-president for Section A, will deliver his address on "The notion of probable error in elementary statistics" Of the two other addresses one will be by Professor Dunham Jackson, retiring president of the Mathematical Association of America, on "The human significance of mathematics," in the second Professor Arnold Dresden, of Swarthmore College, representing the American Mathematical Society, will speak on "Some philosophic aspects of mathematics." The fifth Josiah Willard Gibbs Lecture, under the auspices of the American Mathematical Society and the American Association for the Advancement of Science, is to be delivered at a general session Wednesday afternoon, December 28, by Professor E W Brown, of Yale University, the title of his lecture being "Resonance in the Solar System." The American Mathematical Society will hold sessions for the presentation of papers, Wednesday morning and afternoon and Thursday morning, December 28–29 On Wednesday morning Professor James Pierpont, of Yale University, will deliver an address on "Mathematical Rigor, Past and Present." The Mathematical Association of America will hold morning and afternoon sessions on Friday, addresses will be given by Professors Archibald Henderson, A. R. Crathorne, Jewell Hughes, J. A. Harris and E. P. Lane, and by Vice-principal W. Betz. An informal dinner will be held on the evening of December 29 at the mathematical headquarters, Ward-Belmont College for Women, where the mathematical sessions are also to be held

B. Physics.—Section B of the American Association will meet jointly with the American Physical Society and with the American Meteorological Society. The meetings will occupy Wednesday, Thursday and Friday, December 28 to 30. Wednesday afternoon will be given the retiring vice-presidential address for Section B, by Professor William Duane, of Harvard University, and an address by Dr. C. J. Davisson, of the Bell Telephone Laboratories. Pro-

fessor Duane's title is "The General Radiation." Dr. Davisson has been invited to speak on "Diffraction of Electrons by a Crystal of Nickel," a subject of great significance in the new quantum dynamics. His address will be followed by a discussion. This Christmas meeting of the American Physical Society is also its annual meeting, at which (in alternate years) the address of its president is given. The subject chosen this year by the president of the society, Professor K T Compton, of Princeton University, is "Recent Studies of the Electric Discharge" The address will probably be given Thursday The regular program of the American Physical Society, for the reading of ten-minute papers, will constitute several sessions. Headquarters for physicists will be the Ward-Belmont Dormitories. The American Meteorological Society will hold sessions on Thursday and Friday The society will join with the Association of American Geographers and Section E in a symposium on "The Mississippi River, its Problems and its Control," in which the U S. Weather Bureau will be represented by several speakers. A session will be devoted to the Tennessee Weather Service, with a luncheon or informal dinner, to bring together as many as possible of the original observers and prominent meteorologists whom Tennessee has produced. In the general program, the winds of the United States, climatological observations for students in the field, and many other subjects will be discussed. The meteorological headquarters will be The Hermitage Hotel, Union St. and Sixth Ave.

C Chemistry.—The program of Section C includes several half-day sessions, mainly on Tuesday and Wednesday, December 27 and 28, to avoid as far as possible conflict with the Symposium in Organic Chemistry to be held in Columbus, Ohio, later in the week. Professor Lauder W Jones, the retiring vice-president for the section, will speak on "A Glimpse at Chemistry here and abroad." He has spent much of the last two years in Europe and this address will be very valuable Among others who will address Section C may be mentioned at this time Professor W A. Noyes, of the University of Illinois, Professor Harry B Weiser, of Rice Institute, and Professor James Kendall, of New York University. Professor Noyes will speak on "Valence." Professor Weiser has chosen as the title of his address "Ionic Antagonisms in Colloid Systems" Professor Kendall will give a paper entitled "Separations by the Ionic Migration Method" In addition to the above there will be a number of shorter papers. Section C will meet with Section N on Wednesday forenoon, for a joint session on "Contributions of Other Sciences to Medicine" Headquarters for chemists will be the Sam Davis Hotel, Commerce St. and Seventh Ave.

D. Astronomy.—The American Astronomical Society is not meeting with the association this year and the Nashville program on astronomy will therefore be wholly in the hands of section D. The sessions will occur early in the week, to permit those in attendance to get to New Haven for the meetings of the Astronomical Society there. Nashville was the birthplace and home through youth to manhood of the eminent astronomer Edward Emerson Barnard. The address of the retiring vice-president for the section, Professor R. G Aitken, of the Lick Observatory, will take cognizance of this by reviewing the life and contributions of that illustrious man of science. It will be given in the general session Wednesday evening. The Josiah Willard Gibbs Lecture, of the American Mathematical Society, to be given this year by Professor E W. Brown, of Yale University, on "Resonance in the Solar System," will interest workers in astronomy. It will occur at the general session Wednesday afternoon. Headquarters for astronomers will be the dormitories of the Ward-Belmont College for Women.

E Geology and Geography.—Section E will meet at Nashville Tuesday and Wednesday, December 27 and 28, under the chairmanship of Professor Charles Schuchert, of Yale University, in conjunction with the Association of American Geographers and the National Council of Geography Teachers. The address of the retiring vice-president for the section, Dr George H Ashley, geologist of the Commonwealth of Pennsylvania, will be on "Geology and the World at Large" Section E is arranging a symposium to be held Tuesday, on the "Geology of the Gulf States," to include reviews by state geologists and correlations by specialists. The Association of American Geographers will hold several sessions at Nashville, but information concerning the programs is not at hand. The National Council of Geography Teachers will meet Tuesday and Wednesday, with special emphasis given to the subject of "teacher training." The headquarters of the council will be in West Dormitory, George Peabody College for Teachers.

F. Zoological Sciences.—Section F will present no program of its own at Nashville, since several of the associated societies are to be meeting there. The retiring vice-presidential address for the section will be given by Dr. Winterton C. Curtis, of the University of Missouri, at a dinner for all zoologists, Thursday evening, December 29. His title is "Old Problems and New Technique." The American Society of Zoologists will hold its twenty-fourth annual meeting on Wednesday, Thursday and Friday. Many contributions are to be presented by demonstration or exhibit in the laboratory rather than by formal reading. A biologists' smoker is being arranged.

The Entomological Society of America will hold morning and afternoon sessions on Tuesday and Wednesday, under the presidency of Dr. F. E Lutz, of the American Museum of Natural History A symposium on "The Physiology of Insects" will be held on Tuesday afternoon The annual public address of the society will be delivered by Dr H. T. Fernald, of the Massachusetts Agricultural College There will be exhibits of specimens and equipment. The American Association of Economic Entomologists will hold its fortieth annual meeting from December 27 to 31. The Section of Plant Quarantine and Inspection will meet on Tuesday. Late on Tuesday afternoon and Wednesday morning there will be papers and discussions on apiculture. The regular sessions of the Association of Entomologists will open on Wednesday afternoon The main address will be that of the president, Professor R. W. Harned, head of the Mississippi Plant Board and of the department of entomology at the A and M College of Mississippi The entomologists' dinner will be held on Wednesday evening The papers to be read deal with artificial and natural control of insect pests generally. There will be a joint session of the Association of Entomologists with its Cotton States Branch. The extension entomologists and members of the Insect-Pest Survey will meet Thursday evening Reading of papers will be continued on Friday and the meeting will close on Saturday with a final business session. The American Society of Parasitologists will hold its third annual meeting from December 27 to 30 A special program on the teaching of parasitology has been arranged, with papers and discussions. A series of invited papers will be given on medical problems in parasitology, including the control of malaria and hookworm disease. The address of the retiring president, Dr. R. P. Strong, will be of special interest, for he has just returned from an extended African trip. The Wilson Ornithological Club will hold its annual meeting on Friday and Saturday when morning and afternoon sessions will be devoted to reading of papers by members of the Wilson Club and of the Tennessee Ornithological Society, an affiliated organization. The official business session will be held on Saturday morning, the ornithologists' dinner on Saturday evening, and a special field excursion is planned for Sunday, for those who can take part. The Hermitage Hotel, Union St. and Sixth Ave., is to be headquarters for all these zoological groups.

G. Botanical Sciences.—On Wednesday afternoon, December 28, Section G will hold a joint session with the several botanical societies. Dr. B. M Duggar, of the University of Wisconsin, retiring vice-president for Section G, will deliver an address on "Experimental Evidence upon the Nature of the Mosaic and other Plant Viruses." Dr. Duggar's address will be followed by three invitation papers: "Cell Physiology," by Dr. Charles F Hottes, of the University of Illinois; "Epidemiology of *Puccinia graminis*," by Dr. E C Stakman, of the University of Minnesota, and "Dichogamy in Flowering Plants," by Dr. A. B. Stout, of the New York Botanical Garden The Botanical Society of America will hold its annual meeting from December 28 to 30, under the presidency of Dr Harley H Bartlett, of the University of Michigan. Programs are being arranged for all five sections of the society and there will be joint sessions with Section G of the American Association, the American Phytopathological Society and probably with other societies The physiological section of the Botanical Society will hold a round-table discussion on mineral nutrition. The general section will hold a round-table discussion on the teaching of botany. The annual dinner for all botanists will be held on Friday, December 30, at which time the address of the retiring president, Dr L. H Bailey, will be delivered. The American Phytopathological Society, in conjunction with its Southern Division, will hold sessions on Wednesday, Thursday and Friday, December 28, 29 and 30 Since this meeting is in the South, the plant-disease problems of that region will be emphasized. One session will be devoted to southern crop-disease problems, another to sweet-potato diseases and their control, and a third to tobacco diseases. But northern and western pathologists will find much to interest them in these conferences and in the other sessions that are being arranged There will be joint sessions with Section G and with the mycological section of the Botanical Society of America, a conference on extension work in plant pathology, and a plant-disease-survey round-table discussion. The annual phytopathologists' dinner, with entertainment features, will be held at the Commercial Club on Thursday evening, December 29. The American Society of Plant Physiologists is arranging for three sessions at Nashville and it will hold a joint session with the Physiological Section of the Botanical Society. This is to occur Thursday morning Joint sessions with the horticulturists and with the phytopathologists are also being arranged. Perhaps the most interesting feature of this meeting is to be a program in honor of the two-hundredth anniversary of the publication of Stephen Hales's "Vegetable Staticks." The programs of the Society of Plant Physiologists and the Physiological Section of the Botanical Society, are being arranged to avoid conflict this year. The Sam Davis Hotel, Commerce St. and Seventh Ave., is to be headquarters for all these botanical groups.

F–G. Organizations related to both Sections F

and G, Botanical and Zoological Sciences.—The regular annual meeting of the American Society of Naturalists will be held Friday afternoon, December 30. The session is to be devoted to a symposium on "Temperature and Life." The naturalists' dinner is planned for Friday evening The Hermitage Hotel, Union St and Sixth Ave., is to be headquarters for the society The Ecological Society of America will hold its thirteenth annual meeting December 28 to 30 Besides the regular sessions of the society, joint sessions will be held with the Botanical Society of America, The American Society of Zoologists and the American Society of Naturalists There will be an informal dinner for all who are interested in ecology The Sam Davis Hotel, Commerce St. and Seventh Ave, is to be headquarters for ecologists The American Microscopical Society will hold a business meeting on Wednesday, December 28, at 4 30 The Joint Genetics Section of the Botanical Society of America and the American Society of Zoologists will hold regular sessions for the presentation of papers on Wednesday, Thursday and Friday, December 28, 29 and 30 This organization will join with the Geneticists Interested in Agriculture in a symposium on "Irregularities of Chromosome Behavior in relation to Plant and Animal Improvement," to be led by C B Bridges and A. F Blakeslee. The American Nature-Study Society will hold sessions on Tuesday and Wednesday, December 27 and 28. One session is to be devoted to nature education in the juvenile organizations associated with the Coordinating Council This program is being arranged by Dr Bertha C. Cady, of the Girl Scouts, and the session will have Dr. G Clyde Fisher, of the American Museum of Natural History, as chairman Another is to deal specially with nature education in the South. Papers are to be read by members from many different parts of the United States and the Nashville meeting promises to be specially successful. The Tulane Hotel, Church St and Eighth Ave, is to be headquarters for the nature-study group

H. Anthropology—Section H will hold sessions from December 27 to 30 Dr George L Collie, director of the Beloit-Logan North African Expedition, will exhibit artifacts and skeletons taken from Aurignacian deposits in Algeria, and will present the results of recent exploration in that region. The subject of "Race Crossing, Group and Individual Changes," will occupy one day, while topics of general anthropological interest will also be presented A session will be devoted to the evidences of human occupation of the caves of the Nashville region and to other questions of local archeology. The dinner for anthropologists is planned for Tuesday evening. The Tulane Hotel, Church St. and Eighth Ave., is to be headquarters for anthropologists.

I. Psychology.—Besides the separate session for Section I, at which technical papers will be read, there is to be a joint session of the section with the Southern Association for Philosophy and Psychology, and another with Section Q (Education) There will be a joint dinner with Section Q and the educational fraternity, Phi Delta Kappa, at which the vice-presidential addresses for the two sections will be heard Dr Margaret F. Washburn, the retiring vice-president for Section I, will deliver an address on "Purposive Action." The sessions in psychology are to be held early in the week and one may attend both these and the meeting of the American Psychological Association, which is to occur on Wednesday, Thursday and Friday, in Columbus, Ohio The Southern Society for Philosophy and Psychology is to hold a special meeting this year in order to meet with Section I of the association The regular meeting will be held in Lexington, Virginia, next spring, but the society is highly appreciative of the advantages of holding this special meeting with the section at Nashville All members of the society are urged to attend if possible and to take part in the joint sessions on December 27 The Tulane Hotel, Church and Eighth Streets, is to be headquarters for philosophy and psychology

K. Social and Economic Sciences—Section K will not present a program for the Nashville meeting. It is hoped that the section may take part in the great four-yearly meeting at New York next year. Those who are actively interested in having Section K occupy a place in the American Association commensurate with the importance of its field are invited to contribute ideas and suggestions to the permanent secretary's office early in the year, so that plans for the New York meeting may be inaugurated in ample time The annual meeting of the Metric Association will occur on Tuesday, December 27 The meeting will include conferences on the industrial, engineering and educational aspects of the project for the universal use of the metric system. The first of these will deal with national and international standardization from the standpoint of manufacturers. The engineering conference will deal with electrical, chemical and mechanical engineering in relation to metrology In the educational conference teaching, text-books and measures for home and hospital will be discussed Recent action by the General Federation of Women's Clubs endorsing metric legislation will be reported on. The annual "Metric dinner," at the Andrew Jackson Hotel, will close the meeting.

L. Historical and Philological Sciences.—Section

L of the association operates in two parts, one for that portion of history that deals with the history of science and the other for the linguistic aspects of philology. Those interested in the history of science will find that the Nashville program includes some very important topics presented by some of our best students in this field. The papers on the history of science are not to be brought together in special sessions, however, but will be distributed among the other sections with regard to their subjects. This year marks the two-hundredth anniversary of the death of Sir Isaac Newton and the centenary of the death of the Marquis de Laplace Interesting and important papers on their relation to modern science are being arranged In the field of chemical science there are to be papers on chemical anniversaries in 1927 and on the contributions of Marcelin Berthelot, the centenary of whose death has recently been appropriately celebrated in Paris A program on the work and influence of Stephen Hales is being arranged by the American Society of Plant Physiologists, Hales's best-known publication, "Vegetable Staticks," appeared two hundred years ago, which gives occasion at this time for special attention to his scientific contributions The general session Wednesday evening is to be devoted to an address on the life and work of the eminent astronomer Edward Emerson Barnard, whose birthplace was Nashville As to linguistic science in Section L, the special committee that has for several years done such excellent work in arranging programs in this subject has not been active this year With the affiliation of the Linguistic Society of America with the American Association, that society was requested to arrange a linguistic program for this meeting, which it cordially undertook to do, although its regular meeting does not occur at Nashville. A special committee of the society has prepared an excellent program for Friday, December 30. Professor G M. Bolling, of the Ohio State University, will present a paper entitled "Phonetic Laws admit of no 'Exceptions'" Professor C M. Lotspeich, of the University of Cincinnati, will speak on "Sound Symbolism." Professor T Michelson, of the Smithsonian Institution, will present "Some Algonquian Notes." "The linguistic aspects of a tenth-century Byzantine paraphrase of Onasander" will be discussed by Professor Clarence G Lowe, of Washington University, St. Louis, and "The Latin vi-perfect" is the subject of a paper to be presented by Professor W. Petersen, of the University of Florida. Professor Leonard Bloomfield, of the University of Chicago, and several other well-known scholars will also take part in this program. Headquarters for Section L will be the Hermitage Hotel, Union St. and Sixth Ave.

M. Engineering—Section M is planning a morning and an afternoon session for Wednesday, December 28 In addition to the retiring address of the vice-president for the section, who is Dr. C. R. Richards, of Lehigh University, the morning session will include addresses on such subjects as Hydroelectric Development, Radio Engineering, the Earthquake Situation in the Mississippi Valley, and similar questions of both broad and local interest The afternoon program is being arranged by a committee of engineers of Nashville, Memphis and Chattanooga, of which Dean W H Schuerman is chairman This is to deal with local problems, especially those with broad application There will also be a dinner arranged by the local engineers, with the speaker provided by the section. Engineering headquarters will be the Andrew Jackson Hotel, Deadrick St and Sixth Ave.

N Medical Sciences—Section N, which endeavors to arrange for its sessions discussions in fields where medical sciences and other lines of research overlap, is planning two half-day symposia for the Nashville meeting The morning session will be held jointly with Section C (Chemistry) It will be devoted to "Contributions of Other Sciences to Medicine," with the following papers E C Kendall, of the Mayo Foundation, University of Minnesota, "Contributions of the Chemist to our Knowledge of Biological Oxidations" G H Whipple, dean of the Medical School, University of Rochester, "Contributions of the Biochemist to our Knowledge of Blood in Formation and within the Body" Alfred F Hess, of New York University and Bellevue Medical College, "Contributions of Chemistry, Physics and Pathology to our Understanding of Rickets" L G. Wesson, of the Medical School of Vanderbilt University, "Relationship of Plant Vitamins to Human and Animal Metabolism" Aleš Hrdlička, of the U S National Museum, "Contributions of Anthropology to Medicine" The afternoon session is to be a joint meeting with the American Public Health Association, on the topic "The Medical Problems of the South." It will be opened by the retiring vice-president for the section, Dr Rufus I Cole, director of the Hospital, Rockefeller Institute for Medical Research, who will speak on "The Interrelationship of the Medical Sciences" Other speakers will be Colonel A M. Stimson, Assistant Surgeon-General, U S Public Health Service, Dr. C. C. Bass, of the Medical School of Tulane University, and Dr. R. S. Cunningham, of Vanderbilt University, who will discuss malaria in the South, parasitological problems in the South and tuberculosis in the South. Headquarters for Section N will be the Andrew Jackson Hotel, Deadrick St. and Sixth Ave.

O. Agriculture.—In cooperation with the Association of Economic Entomologists and the Society of Agronomy, Section O is arranging a half-day symposium on "The corn-borer situation," for Tuesday afternoon, December 27. The annual dinner of the section will be the occasion for the presentation of the address of the retiring vice-president for the section, Dr C. F. Marbut, of the U. S. Department of Agriculture, who will speak on "A Hitherto Neglected Factor in the Agricultural Situation" The American Society for Horticultural Science will meet from Tuesday to Thursday, December 27, 28 and 29. A general session on Tuesday morning will have papers mainly on different phases of tomato culture. In the afternoon will be sessions on vegetable culture and pomology Two sessions on Wednesday will deal with (a) "Pollination, Sterility, Fruit-setting, and Spraying," and (b) "Nutritional Relations of Fruit Trees." The Thursday morning session will consider root stocks, propagation, pruning. The afternoon session will be devoted to the address of the president of the society, a business meeting and papers on fruit investigations. The dinner of the society will occur on Wednesday evening Headquarters for horticulturists will be the Tulane Hotel, Church St. and Eighth Ave.

Q Education—Section Q is planning sessions to occupy three days at Nashville, on December 26, 27 and 28 On Monday there will be a session on supervision and one on methods. Among the speakers' names are Courtis, Hennon, Hull, Waples, Gray, Barr, Gates and Ayer. Tuesday is to be devoted to school administration, some of the speakers' names being Strayer, Packer, Englehardt, Clark, Phelps, Ayer, Alexander and Monroe. An annual summary of research will occupy Wednesday, with papers by Courtis, Cade, Garth, Lentz, O'Brien, Pechstein, Cook, McGregory, Donovan, Purdon and others The retiring vice-presidential address for Section Q will be given Tuesday evening by Dr. Melvin E. Haggerty, dean of the college of education of the University of Minnesota, at the joint dinner-meeting of Sections I and Q and the Phi Delta Kappa Fraternity. The Tulane Hotel, Church St. and Eighth Ave., is to be headquarters for philosophy and psychology. Phi Delta Kappa headquarters will be the Andrew Jackson Hotel, Deadrick St. and Sixth Ave.

Organizations not Classified by Sections of the Association.—The Society of the Sigma Xi is to hold a business session and its annual dinner on Tuesday, December 27. The sixth annual Sigma Xi lecture, by Dr. Clarence Cook Little, president of the University of Michigan, on "Opportunities for Research in Mammalian Genetics" will be given at the general session of the association on Tuesday evening. The Tennessee Academy of Science will hold its annual meeting at this time. There will be a special session Monday morning at 10, to welcome visiting members of other academies. The academy is specially interested in the movement to provide opportunities by which the many state academies may cooperate for mutual benefit. The academy will have on exhibition throughout the week a collection of photographs, publications, etc., of the late Edward Emerson Barnard, medals awarded to him, and other Barnardiana. Several scientific fraternities are to have business sessions and dinners in the period of the Nashville meeting, without scientific programs. To be mentioned here are the Gamma Alpha Graduate Scientific Fraternity, the Honor Society of Phi Kappa Phi, the Sigma Delta Epsilon Graduate Women's Scientific Fraternity, the Pi Mu Epsilon Mathematical Fraternity and the Beta Beta Beta National Biological Honor Fraternity.

FURTHER ANNOUNCEMENTS AND REPORTS OF THE NASHVILLE MEETING

Later announcements about the approaching meeting will be made in SCIENCE, and full information will be contained in the General Program, which will be available in the registration offices Monday morning, December 26, and throughout the week of the meeting.

It is planned that a general report of the second Nashville meeting will appear in special issues of SCIENCE to appear on January 27 and February 3. These will contain accounts of the main features of the convention, the business transacted, and especially a full series of readable reports on the section and society programs, the latter reports based on material to be supplied by the secretaries of those organizations. These will be sent to all members. New members who join the association before the time of their publication and all associates for the Nashville meeting will receive the special issues.

SCIENTIFIC EVENTS

THE NEW BIOLOGY BUILDINGS AT THE UNIVERSITY OF BIRMINGHAM

THE new buildings of the University of Birmingham at Edgbaston, which were opened by the prime minister on October 20, will accommodate the departments of botany, zoology and brewing and the biochemistry of fermentation, which have long been inadequately housed in the older part of the university in Edmund Street.

The additions are the fulfilment of a further portion of the original design of Sir Aston Webb. Sir William Waters Butler, Bt., has contributed £40,000 and an anonymous donor £5,000 towards the total cost of

the buildings and equipment, which exceeds £120,000. Zoology occupies the ground floor, brewing and biochemistry of fermentation the greater part of the first floor and botany the second floor, with certain rooms also on the first floor

The departments have already started work in the new buildings, although the internal equipment and furnishing are not yet complete. Apart from facilities for teaching, the zoological department is admirably equipped for research A large sum of money has been expended on apparatus, which includes elaborate instruments used in the newer experimental development of the science The necessity of having the means of keeping marine animals alive far away from the sea has been recognized, and tank rooms have been provided, containing aquaria, with arrangements for filtering, circulating and aerating the sea-water, which will be obtained from Plymouth The new department is particularly well equipped for entomological teaching and research, there being a special room for this work in the building itself and an outdoor laboratory for insect-breeding work, and students will have access to a large fruit farm in Worcestershire for a part of their field training in the agricultural aspect of the subject The brewing and biochemistry of fermentation department consists of a series of sixteen rooms There is a spacious general laboratory, a well-appointed microscope room and a research laboratory A special laboratory is provided for analysis, as well as an incubator room and dark rooms for photography and polarimetric work. The laboratories are equipped with the latest forms of apparatus in addition to recent researches on starch investigations.

The new botanical department comprises some thirty-three rooms, and the laboratories are especially fitted for studying fungi by the method of pure cultures, while ample provision has been made for the study of plant physiology by experiments in which open air is necessary.

DARWIN'S HOME FOR THE NATION

In his presidential address to the British Association, Sir Arthur Keith made an appeal for a fund to purchase Darwin's home at Downe in Kent, where he did most of his epoch-making work, so that it might be preserved for the nation. According to the London correspondent of the *Journal* of the American Medical Association the appeal met with a prompt response. Mr. George Buckston Browne, a retired genito-urinary surgeon, on reading the appeal at once telegraphed to Sir Arthur offering to make himself wholly responsible for the gift. His motive was to allow future generations to see Darwin's home, which, with its estate, might otherwise pass into the hands of builders. The cost, with some endowment fund, is estimated at from $60,000 to $75,000. Mr Browne has made it a condition that no other contributor is to be asked to share the cost with him. He was admitted to the membership of the College of Surgeons in 1874, and for fourteen years acted as assistant to Sir Henry Thompson, the leading genito-urinary specialist of his day. He is an antiquarian and an enthusiastic collector In offering to buy Downe House and to establish a fund for its perpetual upkeep, he is giving expression to his profound admiration for the work of the great naturalist. He considers that the house in which evolution was cradled should be as reverently preserved as Shakespeare's birthplace He desires that the house should be restored as nearly as possible to its condition when Darwin lived there When the house and garden have been restored, he would wish them to be opened without charge to visitors, who could then be shown Darwin's study, laboratory and living rooms much as when he left them. He also expressed the wish that some physician of slender means and good record should be appointed the custodian. Sir Arthur Keith has suggested that out of the endowment fund money should be spared for a prize to be given every second year for the best contribution to biologic knowledge. Downe House is the property of Darwin's son, Professor Francis Darwin and is now used as a school for girls.

BUILDING ACTIVITIES OF THE CHICAGO ZOOLOGICAL SOCIETY

The report of the first year's building activities of the Chicago Zoological Society shows the new park to be well under way and much construction work already completed According to a summary in *Museum News*, it is now estimated that the major portion of the work will be completed by June 1, 1930, and that the park will be opened to the public at that time

During the past few months the new park, which is located to the west of the city proper and just outside the town of Riverside, has been entirely fenced in. Within this enclosure are 133 acres of land and fifty additional acres are available for future development. Over ten miles of sanitary and surface sewers have been laid Water mains have been laid and heating and power lines put in place.

The excavations for three separate lagoons are nearly complete, as well as the construction of a complete power and pumping station. Work has already been started on the group of buildings at the entrance. These will house the administration offices, curators, head keeper, forester, director, the society's meeting room and library. The only exhibition building to be started this year is the reptile house. In addition to the work being done within the new park,

the county has begun the construction of roads which will connect the zoo with the main boulevards of the vicinity

It is felt that the plan for the park embodies some noteworthy features made possible by a study of existing parks in Europe and in this country, and by the fact that the entire park is being planned at one time upon a large scale. Automobile traffic is being entirely separated from pedestrians and will follow a circular roadway just inside the fence

A system of deep moats is to be used in the place of bars to confine the animals whenever possible This and other arrangements will do much to avoid the cramped conditions often prevailing in zoological gardens

While nothing has been done as yet toward acquiring a collection for the new park, a tentative list of inhabitants has been worked out This includes 876 specimens of mammals divided into 269 species; 2,398 birds of 794 species; 300 reptiles representing 75 species, and 90 batrachians of 30 species There will also be an insect collection including about 200 species

SCIENTIFIC NOTES AND NEWS

Dr. Frederic A. Lucas, honorary director of the American Museum of Natural History, has been elected an honorary member of The Museums Association, Great Britain. This is the first time that the distinction, restricted to fifteen persons, has been conferred upon any one outside of Great Britain

In addition to the medals awarded to Dr. W D Coolidge, Professor A. A Noyes and Professor J C McLennan previously announced in Science, the Royal Society has awarded a royal medal to Sir Thomas Lewis, F R.S., for his researches upon the vascular system, following upon his earlier work on the mammalian heart-beat, the Copley medal to Sir Charles Sherrington, O M., F R.S, for his distinguished work on neurology, and the Buchanan medal to Dr. Major Greenwood for his statistical researches and other work in relation to public health.

Dr. Graham Little, member of parliament, for London University, has been elected an honorary member of the Royal Academy of Medicine of Rome, and a fellow of the Royal Society of Physicians of Budapest

A special number of the *Zeitschrift fur physikalische Chemie* has been dedicated to Professor Ernst Cohen, of the University of Utrecht, to commemorate the twenty-fifth year of his professorship.

Professor Paul Lecene, who occupies the chair of surgical pathology in the Paris Faculty of Medicine, has been nominated an officer of the Legion of Honor.

Dr. Lee K. Frankel, former president of the American Public Health Association, will be guest of honor at a testimonial dinner to be given on December 9 at the Biltmore Hotel by friends associated with him in health work The speakers will include Felix M Warburg, Professor C-E A. Winslow and Haley Fiske

Sir Charles Martin, director of the Lister Institute, upon whom the honor of knighthood was recently conferred, has been presented with his portrait by the staff of the institute as a token of personal esteem and appreciation of his great services during the twenty-four years of his directorship The presentation of the portrait took place in the library of the institute on October 28, when Professor Harden presided over a large company of past and present members of staff and research workers

Frederic S Lee, research professor of physiology in Columbia University, has resigned the presidency of the board of managers of the New York Botanical Garden after a service of five years

At the annual meeting of the American Ornithologists' Union held at the U S National Museum from November 14 to 17, the following officers for the year 1926–1927 were elected Alexander Wetmore, assistant secretary of the Smithsonian Institution, *president*, T S Palmer and W. L McAtee, of the U. S. Biological Survey, *secretary and treasurer*

The following officers have been elected by the American Society of Agronomy Dr A G McCall, *president*, Dr. E F Gaines, *first vice-president*, Dean M J. Funchess, *second vice-president*, Professor W. W Burr, *third vice-president*, Dr A B. Beaumont, *fourth vice-president*, Professor J D Luckett, *editor*, and Dr. P. E Brown, *secretary-treasurer*.

Dr. Walter L Niles, dean and professor of clinical medicine of Cornell University Medical College, was elected president of the Association of American Medical Colleges at its recent annual meeting in Montreal, Dr Burton D. Myers, assistant dean and professor of anatomy, Indiana University School of Medicine, Indianapolis, vice-president; Dr. Irving S. Cutter, dean and associate professor of medicine, Northwestern University Medical School, Chicago, chairman of the executive committee, and Dr. Fred C Zapffe, 25 East Washington Street, Chicago, secretary-treasurer. The next annual meeting will be at Indianapolis from October 29 to 31, 1928.

At the annual general meeting of the Mineralogical Society, England, held on November 1, Dr. G. T.

Prior, keeper of the department of minerals in the British Museum, was elected president.

DR. SYLVAN J. CROOKER, formerly with the U. S. Bureau of Standards, has resigned his position as chief engineer of the Whitlock Coil Pipe Company, Hartford, Conn., to become vice-president of the Heat Transfer Products, Inc., a division of the Staten Island Shipbuilding Company, New York City.

HAAKON WEXELSEN, who has been a graduate student in genetics at the University of California for the past year and a half, has been appointed director of Felleskjoepels Experiment Station at Vidarshof, Norway.

A. W. ALLEN was recently appointed editor of *Engineering and Mining Journal*, succeeding J. E. Spurr.

DR. WILBERT W. WEIR, associate soil technologist of the U. S. Bureau of Chemistry and Soils, has accepted a position on the staff of the Chilean Nitrate of Soda Educational Bureau, with headquarters in New York City.

DR. R. E. CLAUSEN, associate professor of genetics at the University of California, has recently returned from sabbatical leave after an absence of fifteen months in Europe. The first twelve months were spent at Stockholm, where he worked in the cytological laboratories of Dr. O. Rosenberg. During the remaining three months he was engaged in an inspection of the research in genetics under way in Europe for the International Education Board, under which he held a fellowship.

DR. FREDERICK G. KEYES, head of the department of chemistry at the Massachusetts Institute of Technology, has arrived in Boston from Paris after an absence of five and a half months, to resume his duties with the department. While in Paris Dr. Keyes acted as representative of the institute at the Marcelin Berthelot centenary memorial.

DR. ROBERT L. PORTER, recently appointed dean of the University of California Medical School, has arrived in San Francisco to take up his new duties after spending three years in study in Rome. While on leave Dr. Porter visited medical schools in Italy, France, Great Britain, Canada and the United States.

DR. H. NOGUCHI, of the Rockefeller Institute, arrived in Accra, on the British Gold Coast, on November 17, to investigate the yellow fever problem.

DR. NIELS NIELSEN, the Danish explorer, has returned to Denmark after a difficult expedition to unknown parts of the interior of Iceland, on which expedition he was accompanied by P. Hannesson and Sturla Jonsson, both Icelanders.

DR. A. W. HILL, director of the Royal Botanic Gardens at Kew, sailed for Australia on November 4 on the invitation of the Commonwealth Council for Scientific and Industrial Research, Melbourne. He will visit the various botanical, agricultural and forestry Institutions in Western Australia, and will then proceed to Adelaide, Melbourne, Sydney and Brisbane.

DR. ANTOINE LACASSAGNE, assistant director of the Radium Institute of the University of Paris, and Professor Hermann Holthusen, of Hamburg, recently spent a few days in New York visiting hospitals and institutions where radium and X-rays are used in the treatment of cancer. Both expect to visit other American cities before going to New Orleans to attend the meeting of the Radiological Society of North America.

PROFESSOR H. N. RUSSELL, of Princeton University, gave a talk at the U. S. Bureau of Standards on November 4, on "The Structure of the Elements of the Iron Group." On October 15, J. W. French, technical director of Barr and Stroud, Ltd., manufacturers of military optical instruments, Glasgow, lectured on "Optical Glass" at the bureau.

DR. W. V. BINGHAM gave an address before the British Psychological Society at the Royal Anthropological Institute, London, on November 2, on "Individual Differences in Susceptibility to Accidents." He has now returned to New York, after visiting technopsychological laboratories in France, Switzerland, Holland, Germany and England. While in Paris he contributed to the Fourth International Conference for Technopsychology a paper on "Neglected Methods in Employment Psychology," and was elected a member of the board of directors of the association.

DR. WALTER S. ADAMS, director of the Mount Wilson Observatory of the Carnegie Institution of Washington, will give a lecture on "The Interior of a Star and how it maintains its Life" on December 6 in the administration building of the institution in Washington.

PROFESSOR ROSWELL JOHNSON, head of the oil and gas school at the University of Pittsburgh, addressed the Sigma Xi alumni club of the University of Pittsburgh on November 29 in the physics lecture room. His topic was "Science in Russia."

DR. DANIEL T. MACDOUGAL, director of the laboratory of plant physiology of the Carnegie Institution of Washington, will read a paper on "Substances regulating the Passage of Materials into and out of

Plant Cells—the Lipoids" before the American Philosophical Society, Philadelphia, on December 2.

DR. HENRY J. VAUGHAN, commissioner of health of Detroit, gave one of the DeLamar lectures in hygiene at the Johns Hopkins University School of Hygiene and Public Health, November 15, on "Municipal Health Administration."

DR. A F SHULL, professor of zoology in the University of Michigan, recently addressed the department of biology of Princeton University on "Photoperiodism and the Wings of Aphids"

A MEETING commemorating the bicentenary of the death of Sir Isaac Newton was held at the American Museum of Natural History on November 26 and 27, under the auspices of the History of Science Society and other scientific organizations, at which many distinguished speakers took part. It is hoped to print a full account of the meeting in an early issue of SCIENCE

A FORMAL ceremony was held at the Warren Anatomical Museum on November 18, when a framed portrait of Dr William Fiske Whitney, former curator of the museum, was unveiled and presented to the Harvard Medical School Dr. Burt Wohlbach introduced Dr George Burgess Magrath, who presented the painting Dr Magrath outlined his contact with Dr Whitney, first as a student and later as a colleague. He portrayed Dr Whitney as a pioneer clinical microscopist, a councilor of surgeons, a gentleman. Dr Edsall, dean of the medical school, received the portrait in the name of the school He showed that Dr Whitney, in his forty-two years of service from 1879–1921 as curator, made the museum what it is to-day, and yet through all the hard work carried himself graciously and kindly

DR. ISRAEL C WHITE, state geologist for West Virginia since 1897, died on November 24 at the age of seventy-nine years

PROFESSOR FRANK WASHINGTON VERY, director of the Westwood Astrophysical Observatory at Westwood, Mass., and formerly professor of astronomy at Brown University, died on November 23, aged seventy-five years.

DR. GEORGE ABBOTT OSBORNE, Walker professor-emeritus of mathematics at the Massachusetts Institute of Technology, died on November 20, aged eighty-eight years.

DR. ALFRED J. M. PAGET, formerly regius professor of physic, University of Cambridge, died on September 15.

SIR WILLIAM GALLOWAY, the distinguished British mining engineer, died on November 2, aged eighty-seven years.

THE death is announced, at the age of seventy-six years of Professor Carlo Fedeli, formerly director of the institute of special medical pathology at the University of Pisa.

THE next World's Dairy Congress will be held in London, England, from June 26 to July 14, 1928. The program as outlined in the preliminary announcements includes papers on all phases of the milk industry and discussions will be led by various American scientists including H. E. Van Norman, O. F. Hunziker, E V. McCollum, M D. Munn and R. S. Breed. An official delegation of dairy scientists from the United States will leave Montreal for the congress on May 15 and June 15, under the direction of R. S. Breed and G. J. Hucker, of Geneva, N. Y.

A SPECIAL meeting was held on November 22 at the New York Academy of Medicine at which various aspects of the cancer problem were discussed. Dr. H. Gideon Wells, of the University of Chicago, spoke on "The Significance of Cancer Statistics," and Dr. I V Hiscock, associate professor of public health at Yale University, discussed his paper Dr Maud Slye, associate professor of pathology at the University of Chicago, talked on the relation of heredity to cancer Her paper was discussed by Dr. James Ewing, professor of pathology, of Cornell University Medical College. "How the Cancer Problem is handled in Massachusetts" was the title of a paper by Dr. Kendall Emerson, of the State Cancer Clinic, Worcester, Mass, which was discussed by Dr. E. H. Lewinski-Corwin, committee on public health relations, New York Academy of Medicine. Dr. Samuel W. Lambert, president of the New York Academy of Medicine, presided.

THE United States Civil Service Commission announces an open competitive examination for senior chemical engineer (pulp and paper), applications for which must be on file with the Civil Service Commission at Washington, D. C., not later than December 27. The examination is to fill a vacancy in the Forest Products Laboratory at Madison, Wis., and vacancies occurring in positions requiring similar qualifications. The salary ranges from $5,200 to $6,000 a year, depending upon the qualifications of the appointee as shown in the examination and the duty to which assigned.

THE American Society of Agronomy, at its recent annual meeting, voted to sponsor a $5,000 nitrogen research award, provided by the Chilean Nitrate of Soda Educational Bureau. The award is given annu-

ally to individuals who have performed outstanding nitrogen research in relation to economic crop production to be used in furthering nitrogen investigations or for professional advancement. The award is to be made by a committee of six appointed by the president of the American Society of Agronomy and the amount of the award is to be determined by the committee in each individual case. In making the award the committee shall consider the work accomplished as indicated by publications and the facilities and funds available for the particular research project The award may be made to any research worker in the United States or Canada The award is to be made annually at the meeting of the American Society of Agronomy. The award committee has not yet been named but will be announced soon

DR LESLIE A KENOYER, of Western State Teachers College, Kalamazoo, has presented to the U S. National Herbarium a collection of about six hundred plants obtained on Barro Colorado Island, Panama, during July and August. The collection contains about 190 species previously unreported for the island, about four of which are new species. The collector is collaborating with Dr Paul C Standley in a publication of these additions to the flora of the island

AT the direction of King Albert a national scientific research fund was constituted on November 26 at a special meeting of the Belgian Academy, called to meet the urgent necessity of raising money to promote research in connection with Belgian institutions of learning.

IT is announced that James N Gamble, of Cincinnati, plans to give funds to Christ's Hospital for the establishment of an institute for medical research The amount is not stated but is said to be several millions of dollars. Mr. Gamble recently gave $500,000 to the building fund of the hospital.

THE class of '30 at Lehigh University has raised $3,000 for two chemical research fellowships, to which H C. Jones, of Wilkes-Barre, and R. J De Gray, of Ramsey, N. J., have been appointed

A GIFT of $40,000 from the John A. Finch estate will make possible the erection of a thirty-five bed hospital on the campus of Washington State College at Pullman which, it is expected, will be completed by September, 1928, and will cost about $85,000.

THE department of mineralogy and petrography at Harvard University was enabled, through the Holden Travel Fund, to send out four parties during the past summer for the collection of material for research and exhibition at the university museum. Harry Berman, museum assistant, went to Mexico on a joint collecting trip with Dr. W. F. Foshag, of the United States National Museum. A third expedition was made by Professor E. S. Larsen, who went to southern California in the vicinity of Elsinore, where he mapped the geology of a region hitherto undescribed. The research will be continued next summer. Professor Charles Palache and L. W. Lewis visited a number of mines in Canada, bringing back collections for exhibition from the silver mines of Cobalt, Ontario and the Lucey Mica Mine at Sydenham, Canada.

AT the opening of the present academic year four members of the staff of the Clark School of Geography went into camp with twenty-five graduate students, with plans for making an economic survey of Greenfield, Massachusetts, and vicinity The camp was placed in the Berkshire Hills, three miles west of Greenfield. There is a two-fold purpose in the establishment of this field school of geography. one is to provide definite training in field methods for those entering the profession; the other is to experiment in the development of field methods in geography, and in the working out of an economic survey of a portion of the Connecticut Valley and bordering uplands, which would be of value to the people living in that community The plans have been made to take successively portions of the Connecticut Valley lowland and continue the work until a considerable section of that part of New England has been studied intensively The instructional work was under the direction of Drs Wallace W. Atwood, Clarence F. Jones, W Elmer Ekblaw and Charles F Brooks.

THE topographical department of the Danish general staff despatched a survey expedition to Greenland last May. It is under the command of Captain F C Jorgensen and is based on Disko Island The projected program of survey work will probably take thirty years to carry out. In addition, the expedition will supervise the construction of seismographic and wireless stations at Scoresby Sound.

AN Italian Arctic expedition by airship is being planned for next year. According to the foreign press, the expedition will be organized and led by General U. Nobile, who accompanied Captain R Amundsen in his polar flight in 1926 The Italian government has offered airship N.4, which is a sister ship of the *Norge*, used on that occasion, and the Norwegian Aero Club has promised the use of airship sheds at Vadsö and King's Bay. General Nobile intends to make his Arctic base in Spitzbergen and to explore eastward to the north of Siberia, intending no doubt to throw light on the unknown northward extension of Nicholas Land. He proposes also to make a flight to the Pole. The Soviet government has expressed a wish to help by establishing a base with supplies at the mouth of the Yenisei River. At present a com-

mittee at Milan is considering the cost of the project. The Royal Italian Geographical Society has promised its support.

The U. S National Museum recently received as a gift the collection of insects belonging to Geo M. Greene, of Harrisburg, Pennsylvania. Mr Greene began to form this collection in 1893 and devoted himself principally to Coleoptera, although his collection contains several thousand named and arranged specimens in other orders The collection is of unusual value because the specimens are neatly and completely labeled, well mounted and thoroughly classified. The beetles alone number over 42,000 specimens H S Barber and C T Greene, of the U. S Bureau of Entomology, made a trip by automobile to Philadelphia on October 21 and 22, to bring the Geo M Greene collection to the museum

UNIVERSITY AND EDUCATIONAL NOTES

Under the will of Frank Thorne Patterson, of Philadelphia, his estate, after the death of his widow, is to be divided between Jefferson Medical College, the hospital of the University of Pennsylvania, Pennsylvania Museum and the School of Industrial Art and Bryn Mawr Hospital The value of the estate is estimated at approximately $2,120,000

The late Nina Lea, of Philadelphia, has bequeathed to the University of Pennsylvania and Harvard University $150,000 each, to endow professorships in memory of her father, Henry Charles Lea, well-known historian

Dr A. F O Germann has been granted a leave of absence from Valparaiso University, to return to his former position of research director for the Laboratory Products Company, Cleveland Harry V. Fuller, formerly professor of chemistry at Pei Yang University, China, has accepted the position of acting professor of chemistry at Valparaiso University in Professor Germann's absence

Dr. Gordon Whyburn has been promoted to a full professorship of mathematics at the University of Texas.

Brenton R Lutz, of the department of biology at Boston University, has been promoted from assistant professor to professor in the department.

Dr. Elmer L Sevringhaus has been transferred from associate professor of physiological chemistry to associate professor of medicine and associate physician to the Wisconsin General Hospital, Madison, and Dr. Edgar J Witzemann, formerly of the Mayo Clinic, has been appointed assistant professor of physiological chemistry, to succeed Dr Sevringhaus.

Dr. Leslie Hellerman, who has been research instructor at the University of Chicago, has received an appointment in the department of physiological chemistry of the Johns Hopkins University Medical School as associate.

Miss Minnie A Graham, associate professor of chemistry at Mills College, has been appointed professor of chemistry in the Dominican College of San Rafael.

DISCUSSION AND CORRESPONDENCE

TUMORS IN THE LOWER CARBONIFEROUS

Unusual growths on the fin spines of modern fishes have been known for a long time under the name of Osteomae. They are hard, dense and almost ivory-like I do not know what produces these pathological growths, since no one has studied them for the determination of this point, so far as I know. While summarizing our knowledge of pathological conditions[1] among fossil vertebrates I mentioned these growths as possible tumors, and stated that they were unknown among fossil fishes.

Recently Mr Errol Ivor White[2] has sent me his paper describing a collection of fishes from sections of the Lower Carboniferous rocks below Newton Farm in the parish of Foulden, five miles west of Berwick-on-Tweed, by the youthful Thomas M. Ovens, whose death at the age of nineteen cut short what might have been a marvelous intellectual career.

One of the incomplete specimens of *Phanerosteon mirabile* Traquair shows on the anal radials "bladder-wrack"[3] osteomae, which are so common in some types of living fishes This discovery is not only the first of the fossil osteomae, but it is the earliest geological record of any pathological growth in the vertebrate group. It is the earliest pathological record.

Roy L. Moodie

Santa Monica, California

MASTODON REMAINS IN WASHINGTON

About the middle of August there was found on the property of Virgil Schaefer, about four miles northeast of the village of Blyn, Clallam County, Washington, some remains of a mastodon. Because of the

[1] "Paleopathology, an Introduction to the Study of Ancient Evidences of Disease" Chapter iii. Urbana, 1923

[2] "The Fish Fauna of the Cement Stones of Foulden, Berwickshire." *Trans. Roy Soc. Edinburgh*, LV, pt. I (No. 11), p 268, 1927 Text figure 19, A.

[3] A seaweed, *Fucus vesiculosus*, yielding material prescribed for obesity, goiter, etc.

location, the northeast corner of the Olympic Peninsula, the matter seems worthy of record

The find included two tusks in a fair state of preservation, one entire and one broken in two. The tusks were 64 and 64 3/16 inches long, respectively, the measurement being made on the outer curve The diameter at the base was slightly over 20 inches The weight was estimated at 35 pounds

Just below the base of the tusks, which were in a horizontal position, were five teeth and a number of bony fragments, presumably of the jaw One tooth comprised five sets of triple protuberances which were well pointed Another tooth comprised four sets of triple protuberances with a fifth small stub The enamel in both of these was in good condition The other three teeth, each three and one-half to five and one-half inches long, comprised three sets each of double protuberances, in one case worn down about three-fourths of an inch, in the second, worn slightly more, and in the third, the smallest of the group, worn to the base of the points

The bones were found in the course of the digging of a ditch to drain a swampy area which has been a beaver swamp within the memory of the present inhabitants of the region The following section was exposed in the trench.

a. peaty bog muck, 2 feet 0 inches, b marly clay, 0 feet 1 inch, c peaty clay, dark, 2 feet 6 inches, d sandy clay, fossiliferous, 1 foot 0 inches (base concealed).

The fossils have not been studied, but include abundant fragments of minute gastropods and other shells The mastodon remains were in the layer c approximately three feet below the present surface of the swamp, which is not far above sea-level

HAROLD E CULVER

STATE GEOLOGIST OF WASHINGTON

AVAILABLE MATERIAL IN COMPARATIVE ANATOMY AND PATHOLOGY

THE Laboratory of Comparative Pathology of the Philadelphia Zoological Society has rather extensive material of anatomical and of pathological character, some of which is not entirely used by the laboratory personnel. It has been our policy to supply to accredited investigators a moderate amount of material for their problems.

I am writing this letter to make it more generally known that material is available, because we wish no opportunities lost to be of service to workers in these general lines. This material will be given to research and teaching institutions that receive the approval of the American Association for the Advancement of Science. It will be sold to dealers whose business it is to distribute material.

Since this laboratory has no shipping department, it will be necessary for workers who desire material to supply us with mailing and express cases suitable for the specimens they desire, and to pay postage and expressage The laboratory can not engage to embalm or inject tissues free of charge, but may be able to undertake small problems of this kind for the time-cost of the labor.

There are now available a moderate number of male and female genital tracts and of intestinal tracts. A few central nervous systems and ductless glands may also be supplied, but many of these in our laboratory are already preempted The group specimens are grossly normal, but have not been investigated microscopically.

In so far as pathological material is concerned, the laboratory will supply only what develops in the routine autopsies and is not needed for museum purposes Specimens needed for the collection, and those already mounted for the museum will not be supplied.

HERBERT FOX

THE ZOOLOGICAL SOCIETY
OF PHILADELPHIA

REPORT OF THE RANSOM MEMORIAL COMMITTEE

THE committee which has been in charge of the establishment of a memorial to the late Dr Brayton H Ransom, after a careful study of the opinions expressed in answer to a questionnaire on the subject and a consideration of the limitations placed on the choice of a memorial by the size of the fund, has come to a decision as to the form to be taken by the memorial It has been decided that the fund be invested and that the interest be used as a money prize of $100 when that amount is available, to be awarded by the committee to a person of any nationality who has not passed his fortieth birthday at the time of the award, and who has made a comparatively recent noteworthy contribution in the field of parasitology.

The fund at present totals $930 in actual subscriptions and $135 in unpaid pledges, approximately 100 persons, representing fifteen countries in addition to the United States, having cooperated in bringing the fund to its present status, the individual contributions ranging from $1 to $100

The fund has thus far been kept in a savings account drawing the usual interest, in the hope that a $1,000 total might be actually available for investing in a more remunerative manner, the question of investment is now being carefully investigated by the committee.

It is hoped that outstanding pledges will be paid in the near future and that any persons still desirous of joining in the establishment of this memorial to Dr. Ransom will not delay longer.

ELOISE B. CRAM,
Secretary, Ransom Memorial Committee
BUREAU OF ANIMAL INDUSTRY,
WASHINGTON, D. C

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE DEVICE FOR WASHING CULTURE TUBES

ONE of the most irksome and time-consuming operations of the bacteriological laboratory is the washing of culture tubes Recently, we have been using a very simple piece of apparatus which has proved to be so satisfactory in this laboratory that we believe others will find it useful.

The device consists of a water-motor which attaches directly to the faucet by means of a screw connection. A 4-inch motor furnishing 1/8 h. p. on 80 pounds water pressure with a free speed of 4,500 revolutions per minute is used. Because of its simplicity, cheapness and ease of control this motor appears to be more satisfactory for the purpose than an electric motor The test-tube brush is attached to the motor shaft by means of a metal chuck We have found it more satisfactory to employ only about two inches of the bristle-tipped portion of the brush in a chuck about six inches long. This arrangement causes the brush to revolve steadily when running free and facilitates insertion into the tube. Brushes with straight bristle-tipped ends have been found more satisfactory than the newer kinds with the so-called "spray tuft" end. After the tubes have been given the preliminary preparation for brushing they can be handled rapidly and with much less breakage than by the method of hand brushing The rate should approximate 800 to 1,000 tubes per hour.

So far as we are aware none of the supply houses is furnishing the complete apparatus at the present time. The chuck we are using can be made in a few minutes from a piece of brass rod of suitable size for attachment to the motor shaft and turned down to a diameter of about 1/4 inch. A hole drilled in the end of the rod receives the brush wire, which is held in place by means of a screw. The entire apparatus costs only a few dollars.

I. M. LEWIS
UNIVERSITY OF TEXAS

SPECIAL ARTICLES

NOTES ON A SPECIES CROSS IN MICE AND ON AN HYPOTHESIS CONCERNING THE QUANTITATIVE POTENTIALITY OF GENES

SPECIES crosses in laboratory rodents are not very numerous. That of *Cavia rufescens* Lund and *C. porcellus* Linn reported by Detlefsen,[1] and of *Rattus rattus* × *R. alexandrinus* studied by de L'Isle ('65),[2] and of Morgan,[3] are among the more important.

The present note deals with a cross between males of *Mus wagneri* (Eversman) from China[4] and tame *Mus musculus* females of a dilute brown race which has been inbred brother to sister in my laboratory since 1909.

Mus wagneri is small, nervously active, with relatively long ears and short tail, and is white-bellied, black agouti in color This color variety was first described genetically by Cuénot[5] as a "gris à ventre blanc" It is allelomorphic and epistatic to ordinary grey-bellied black agouti.

The hybrids were easily obtained, grew vigorously, and were intermediate in size between the two parent species In color they were white-bellied black agouti, but with deeper pigmentation than that of *M. wagneri*. In many of them the proportion of black hairs on the dorsal surface was very high, suggesting a weakened condition of the agouti pattern. The same tendency was seen in the ventral surface where dark-tipped hairs frequently were found in areas which in contrast to the white-tipped hairs gave a pattern which we have described as a "vest." It is extremely interesting to note this condition, which will again be referred to.

The three recessive genes of the dilute brown *M. musculus* females—a. (non agouti), b (brown) and d. (dilution) disappeared in F_1 just as they would have done had the white-bellied black agouti pattern of *M. wagneri* been that of the same color variety of *M. musculus*.

A back cross of F_1 males and dilute brown females showed segregation of the three genes. The eight classes listed below were expected in equal numbers. The actual figures, however, depart widely from equality as follows:

[1] *Publ. Carnegie Inst of Wash.* (1914) No. 205.

[2] *Arch. f. Rassen u. Gesellschafts Biologie* (1911) 8; 697.

[3] *Am. Nat* (1907) 43; 132–

[4] I am greatly indebted to Dr. Sheo Nan Cheer, who personally brought with him from China the live specimens of *M. wagneri* which form my breeding stock of that species.

[5] *Arch. Zool. Exp. et Gén.* (1911) 8, 40–56.

	Black agouti white belly	Black	Dilute black agouti white belly	Brown agouti white belly	Dilute black	Dilute brown agouti white belly	Brown	Dilute brown	Total
Observed	31	30	10	19	23	21	16	13	163
Expected	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	163.2

If the pairs of genes are considered separately, we find that there are 94 animals with gene B(black) and 69 without it. There are 96 with gene D(intensity) and 67 with d(dilution), while there are 81 with A^w (agouti white belly) and 82 with a (non-agouti). Obviously the chief excess is found in black or intense animals. When these two genes are found together it appears that there are 61 animals, while those with (b) and (d) number 34. Those with (B) and (d), 33, and those with (b) and (D), 35. A somewhat similar excess of animals which had both (B) and (D) was observed in a cross reported by the writer and Phillips,[6] between color varieties within the species *M. musculus*. It is probable that it depends upon death of recessive color combinations rather than upon any linkage or other gametic disproportion.

The "vested" variety is an extremely interesting phenomenon. What perhaps is a somewhat similar condition in that it involves a "weakening" of the agouti pattern was observed by Detlefsen in the case of the guinea pig hybrids referred to above. In his material almost complete disappearance of "ticked" hairs was observed on the dorsal surface in some hybrids. The same phenomenon has been observed in the mice.

Morgan reports a weakened condition of the black factor in F_1 generation mice produced in a cross between a small Japanese-waltzing male and a larger brown non-waltzing female. It is interesting to note that Japanese-waltzing mice are, by many, believed to be descended from *M. wagneri* (see Gates[7]).

At all events we have in three crosses, two of which *do*, and one of which *may* involve specific differences, distinct evidence of "weakened" activity of three epistatic genes introduced by males of the smaller species or variety.

This suggests an interesting line of reasoning as follows:

In addition to the qualitative attributes which distinguish it, each gene may have a quantitative potentiality adapted by natural selection to the size of the body which its activity must cover.

Since activity of genes in development is undoubtedly related in some way to liberation of energy, and since liberation of energy means previous storing of energy, it seems likely that a species will by natural selection eliminate those individuals wasteful enough to build more of such potential activity than is commonly called upon. This would follow since surplus material would require additional food and storage space and would tax more than was necessary the systems by which waste products of metabolism were eliminated.

When a species cross is made resulting in an F_1 hybrid of distinctly larger size than that of the small parent species, the genes of the latter adapted in their physiological activity to covering only a certain more or less limited body area, may find themselves unable to act over the whole of the body of the larger hybrid, and as a result the recessive gene would partially express itself. Such was actually the case in the three crosses referred to. The rôle of the cytoplasm in determining the degree or extent to which the gene may act is also possibly a matter of great importance in this connection. Data on reciprocal crosses in the three cases in question are not as yet available.

The principle of the quantitative limits of gene activity will, if established, be an interesting line of research to follow in size inheritance and in many other genetic problems of birds and mammals.

C. C. LITTLE
LABORATORY OF MAMMAL GENETICS,
ANN ARBOR, MICH.

6 *Am. Nat.* (1913) 47, 760–765.

7 *Publ. Carnegie Inst. of Wash.* (1926) No. 337.

THE ABSORPTION SPECTRUM OF MERCURY AT HIGH PRESSURE ADMIXED WITH NITROGEN[1]

A CONSPICUOUS feature of the absorption spectrum of mercury, as shown by Mohler and Moore,[2] is the appearance of a train of eighteen flutings reaching their optimum range of 2770–2930 A at 420° C. (2100 mm.).

In the present work, when 13 mm. of pure nitrogen gas was admitted to the same 40 cm quartz absorption tube before sealing off and spectra photographed using the same source of radiation (a high potential discharge in hydrogen), this system of flutings was extended on the red to 3087 A at temperatures of 215–305° (28–215 mm. Hg) and on the violet to

1 Publication approved by the Director of the U. S. Bureau of Standards, Department of Commerce.

2 Mohler and Moore, *J. Optical Soc. Am.* 15, p. 74 (1927).

2666 A at 425–530° (1820–7250 mm. Hg). The longer wave length bands (3087, 3063, 3042, 3000, 2980, 2962, and 2944 A) show an average frequency separation of 225 cm $^{-1}$, nearly double the intervals obtained with pure vapor Some 32 bands were found within the range 2919–2666 A at higher pressures, with a wave length separation of 12 A at the beginning and 5 A at the end of the series. Seventeen of these bands within the range 2762–2666 A represent a definite extension on the short wave length side to those previously reported

Lord Rayleigh[3] has announced the occurrence of fifty absorption bands in the region 2697–3055 A with a long column of vapor Altogether 42 such bands were found in the present work with 13 mm. of nitrogen, and the increase of 24 (42–18) indicates that nitrogen does exert a specific rôle, although it may not be a determining factor with a long vapor column A shorter band at 2528 A, however, was always obtained with mercury-nitrogen mixtures and appears to be very definitely conditioned by the presence of this gas This new band was seen within the temperature limits 230–430° C with 13 mm. of gas, but appeared only at temperatures less than 250° (77 mm Hg) with 30 cm. of gas In runs made with a 90 cm. Pyrex tube provided with quartz windows, the 2528 band invariably was found to appear at temperatures below which the resonance broadening on the violet did not become greater than 9 A, thus overlapping and fusing with this band Nitrogen pressures of 13 mm., 30 and 50 cm were used in these trials Pressure conditions, however, were much less definite than with exposures taken with the 40 cm quartz tube.

Data procured from the present photographs on resonance widths at various temperatures confirm R W Wood's[4] first qualitative observations on the symmetrical broadening of resonance absorption at intermediate pressures, and asymmetrical broadening (*i.e.*, towards the red only) at higher pressures for mercury vapor admixed with a foreign gas. It is evident, however, that widths found at lower temperatures (150–250°) are misleading if no allowance is made for the 2540 and 2528 bands The present measurements show that resonance broadening increases with the pressure of nitrogen. At 350° with 30 cm. of nitrogen, a maximum displacement of 32 A to the violet was obtained. The displacements toward the violet with 13 mm of nitrogen are only 2–4 A in excess of blank trials made without gas. Broadening toward the violet in the presence of nitrogen is a very complex phenomenon, but bears no evident relation to the appearance of new spectral bands. Nitrogen, even at high pressures, does not seem to hasten markedly the rate of broadening on the red at high temperatures Born and Franck's[5] concept of three body collisions may be applicable in this connection, for it is clear that a red quantum will suffice to raise the Hg atom to the $^3P_1$ state if the impacting nitrogen molecule or mercury atom contributes the necessary energy difference at the expense of their own translational energy. Such a picture is dynamically impossible for broadening on the violet

The action of nitrogen in developing new spectral bands admits of no clear-cut interpretation The 2528 band, evidently characteristic of mercury-nitrogen mixtures since it appeared with all pressures of nitrogen, can not be correlated with the additional flutings obtained only with 13 mm of nitrogen Paul D Foote, in his very recent quantitative treatment of the mechanisms involved in the quenching of resonance radiation by foreign gases,[6] has pointed out that Hg_2 molecules are produced by collision of excited mercury and normal mercury atoms and that the presence of nitrogen favors this process In this case the extension of the fluting system may be ascribed to the increase in the concentration of Hg_2, resulting from the combined effect of the nitrogen and the radiation used as a source This consideration, it must be noted, explains only the extension of the fluting series observed in pure mercury

There is, however, another possibility. One might expect that high pressures of nitrogen and high temperatures would favor the production of unstable or quasi-stable HgN_2 molecules. Possibly such coupling occurs only between nitrogen molecules and excited mercury atoms Foote's work suggests, further, that an optimum pressure of nitrogen produces a maximum number of $^3P_0$ Hg atoms. The life of the $^3P_0$ state is inversely proportional to the pressure of nitrogen. An equilibrium eventually must be set up between the number of $^3P_0$ atoms produced and destroyed by nitrogen Such considerations make it appear possible that the additional flutings on the red represent the vibrational spectra of HgN_2 molecules formed in this way The absence of these bands with higher pressures of nitrogen is then a necessary consequence of quenching, by the gas, of $^3P_0$ Hg atoms. Obviously these hypotheses suggest many experiments, but circumstances made it impossible for the writer to continue the research.

HOWARD R. MOORE

BUREAU OF STANDARDS,
WASHINGTON, D. C

[3] Rayleigh, *Nature* 119, p. 778 (1927)

[4] Wood, *Astrophys J.* 26, p 41 (1907).

[5] Born and Franck, *Zeits. f. Physik.* 31, p. 411 (1925).

[6] Foote, *Phys. Review* 30, p. 288, September, 1927.

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HOSPITAL AND LABORATORY[1]

THE formal opening of this hospital and clinic is significant of something of far greater importance than throwing open the doors of a new building which is imposing and beautiful in its architectural details and perfectly adapted in its plan and equipment to the purposes for which it is intended. This occasion signalizes the inauguration of a great experiment, for which the erection of this magnificent building, the installation of the splendid equipment, and the gathering together of the trained men who are to work within its walls represent but the collection of utensils and apparatus to be used in the performance of the test. That such elaborate plans should have been prepared indicates that those who have been responsible for this great undertaking possess a profound and abiding conviction and belief in the probable correctness of the idea, the truth or falsity of which is to be tested. These intrepid innovators believe that that branch of knowledge which has to do with disease in man has reached a stage in its development which entitles it to occupy a dignified and important place in the group of subjects which the university considers its domain The fund of information concerning disease has grown to a sufficient bulk, the methods devised for its investigation have become sufficiently accurate, the subject itself is of sufficient interest, and its importance in all that relates to human welfare is sufficiently great to justify the prosecution of its study as an aid in the interpretation of nature, and not, as in the past, only as a part of the discipline required for engaging in a practical profession. This idea is not new, it did not originate in the minds of those responsible for this experiment, it did not spring forth fully formed like Minerva from the head of Jove. There have been many preliminary experiments, *Vorversuche*, but here in this relatively young university, which has been the cradle of so many fruitful innovations in the field of education, this idea is to receive a trial with facilities worthy of the importance of the issue.

It is especially appropriate that this experiment should be made in this great institution whose own commencement involved not one, but many experiments. President Harper early spoke of this univer-

[1] Address delivered at the dedication of the Albert Merritt Billings Hospital and the Max Epstein Clinic of the University of Chicago, November 1, 1927.

sity as "an institution in which a score or more of new educational experiments are being tried." You will recall that, from the instant that his interest was aroused in this institution, the idea of a *university* was uppermost in his mind He could not entertain the notion of the development of another college and his enthusiasm was really only awakened when resources were made available to found an institution which should be not merely a training school, nor even a place where learning and culture should be preserved and fostered, but which should be a workshop in which the boundaries of knowledge should be extended and the innermost secrets of nature be investigated

It was the natural outcome of its earlier existence that at the new University of Chicago attention should have been given first to those branches of human knowledge which have to do with man's spiritual needs and social relationships. But before the institution opened its doors it was possible to announce that, through the generosity of a great benefactor, there should be established as a part of the university, a school of science, a department in which the world of nature would be studied and investigated. In this department special attention was to be given to the encouragement of research, more emphasis was to be placed on the skill of professors to investigate than on their ability to teach. It is of interest that in this school of science the departments were to be those of physics, chemistry, biology, geology and mineralogy, and astronomy. While under biology may be included the study of the human species, yet, in the past, in departments of biology, the study has usually included all living things except man. The study of the structure and functions of the human body has been held to be the prerogative of those undertaking a special vocation or profession. An educated man should know something about physics and chemistry, he needs to know *nothing* about human anatomy or physiology. Indeed it has been considered not quite natural or proper for him to want to know, unless he is to use this knowledge practically. Those were not subjects for general culture. They belonged in the technical school which might, or might not, be affiliated with the university, but they were not real, integral members of the group of university branches of study. In the investigation of natural phenomena, the inquiry as to the nature of man has come relatively late. Astronomy long preceded anatomy. Possibly the reason was a realization of the difficulties of this investigation; more likely there has been a fear of uncovering secrets that have seemed almost sacred.

Very early, however, this university recognized that human anatomy and human physiology thrive best when each can have an independent existence, free from the restraints imposed by the exclusive preparation of students for the practice of medicine. Housed in buildings on the university campus, adjacent to the departments of physics, chemistry and the other branches of natural science, these departments were incorporated as true university departments in the Ogden School of Science, and they have grown to occupy important and dignified positions. The facilities of these departments have been open to all who were prepared to profit by the opportunities offered. It is true that most of the students have expected to engage in the practice of medicine, but the fact that these departments have functioned as university departments, in which a foremost place has been given to the extension of knowledge, has been an important factor in determining the high quality of the work which they have accomplished

The study of the abnormal, the unusual, in the structure and function of man has, however, until now not been undertaken in the same way. For many years all who have been interested in medical education have desired to see this university wholeheartedly enter this field. Years ago Mr. Gates, the great supporter and promoter of all that is good in this university, wrote, "this conception, has been one of the dreams of my own mind, at least, of a medical college . . . , magnificently endowed, devoted primarily to investigation, making practice itself an incident of investigation, and taking as students only the choicest spirits." In this statement Mr. Gates gave expression to the age-old view that it is necessary to combine all that which relates to the study of the structure and function of man, in health and in disease, in one department, a department of medicine, or, as he inadvertently said, a "college," a term which, used in connection with higher education, was anathema to President Harper. The delay in the incorporation of a "college of medicine" within this university, therefore, may have been for good. It has permitted the independent foundation of the departments of physiology and anatomy and it now permits the experiment of establishing within the university a true university department of medicine, or better, a department of pathology in the broadest use of the term, which includes not only the study of disease but also the investigation of methods for its prevention and eradication.

When President Burton took up the duties which had to be relinquished by President Judson, the idea of a university department of medicine found fertile soil. His long experience in teaching and investigation made him enthusiastic regarding this point of view. In a conversation with him concerning this matter, I well remember his saying, in substance, "I

know little about medical education but I have had a long experience in theological schools. It was only when we gave up training men to preach and began to assist them in the study of theology that we began to have results commensurate with our efforts, not only in developing scholars, but in producing worthy ministers of the Gospel as well." It was only natural, therefore, that under the guidance of this man the determination to test the effectiveness of this conception should have been made, and under him and President Mason and Professor McLean all the preparations for the experiment have been carried out.

It is unnecessary to speak to this audience of the practical importance of the study of disease or to recall the results which have already been attained in the relief of suffering and the prolongation of human life, through the acquisition of knowledge concerning this great impediment to the enjoyment of happiness and obstacle to human welfare. As a result of increased knowledge, uninhabitable parts of the world have been made pleasant, many infectious diseases, such as yellow fever, have been all but eradicated, the occurrence of diseases like typhoid fever has been markedly diminished, severe diseases, such as diphtheria, have been made almost harmless, and the effects of certain widespread and distressing maladies, such as diabetes, have been extraordinarily reduced. These are but a few of the beneficent results flowing directly from the increase in knowledge concerning disease. The possibilities of blessing to come are enormously greater. That all infectious diseases can be prevented or eradicated is not beyond the bounds of possibility. What would a contemporary of Queen Elizabeth have said if he had been told that in three hundred years in a city many times the size of London not a pock-marked face would be seen on the streets, not a soul would suffer the annoyance of the itch, and that most of the population would never have heard of the plague.

But ignorance concerning disease is still appalling. One who has never stood by the bedside of a loved one dying of disease, conscious that his efforts are rendered useless solely through ignorance, which in the present state of the basic sciences might be removed, has never tasted the bitterness of grief. Preventable disease and misery are still with us. Present knowledge was not able to prevent in 1918 the spread of a disease which swept over the entire world and in the course of a few months was responsible for the deaths of over half a million people in this country or five times the number of our soldiers that lost their lives in the war. It is estimated that in India 6,000,000 people died during the visitation of this epidemic. Let us not only say, let there be no more war, but let us also say, let there be no more epidemics.

Probably even still more important than the practical results in the prevention and cure of disease are the possible effects which the study of disease may have on prevailing biological theories and laws. It has not infrequently happened that the unusual and bizarre in nature have stimulated man's imagination and have led him to undertake investigations which have finally resulted in the formulation of general laws. Observation of the rainbow led to important discoveries in the field of optics, observation of lightning directed man's attention to the study of electricity.

The investigation of all biological phenomena is attended with great difficulty. During the past century great progress has been made, yet it can not be held that the formulation of any laws or generalizations regarding biological phenomena has been comparable in significance with the discovery of the laws regarding gravitation, the conservation of matter or the laws of thermodynamics. The methods to be employed in the investigation of biological phenomena are in principle the same as those which have been so productive in investigation in other branches of science, the results of which have been to give man that marvelous control over the forces of nature, the blessings of which we enjoy but hardly appreciate. Man tried for a thousand years to learn about his environment solely by exercising his reasoning powers, and the result was the dark ages. But in the seventeenth century there was introduced into his armamentarium a new weapon, a new method, the method of experiment. Man began to observe, to think, to try. Before he had only thought. The past three hundred years may be set apart from all that preceded as the Age of Experiment. What is called the scientific method has almost banished darkness from the earth, has almost annihilated distance and has lengthened time.

There have been many attempts to analyze the scientific method, though usually not by scientists themselves, for as one scientist has said, too great self-consciousness might make him lose his power "like the famous centipede, who after profound analysis of his own method of locomotion, found he could not walk." In the scientific method there are undoubtedly three kinds of activity always engaged in, seeing, thinking and doing. But probably rarely, and then only in the simplest cases, are these employed in strict succession. In profitable investigation the observer thinks and the thinker observes. The hypothesis, as we say, frames itself and the trial is made. No question, however, is ever settled by one experiment. The experiment must be repeated, the conditions changed, new observations made, thinking and reasoning going on all the time, until there emerges the answer to the question.

Certain students of the nature of science itself have attempted to classify the various branches of science, and have called certain ones, such as physics and chemistry, in which accurate measurements are important and in which the abstractions of mathematics are largely employed in interpreting results, the exact sciences and have called those branches of science in which, for the present at least, accurate measurements are not so important, the descriptive sciences. All science however is descriptive Science is an attempt to describe natural phenomena in comprehensible terms Certain it is that the greater the number of generalizations which are true, or at least seem to be true, for a large class of reactions, the more simple and understandable the subject becomes, and the more these laws can be reduced to mathematical exactness the more useful they are. But we are in possession of a vast store of knowledge which has been of the greatest benefit to mankind, but to which, at present, the methods of quantitative measurement are not applicable There has even been an attempt to deny the value of all investigation that is not strictly quantitative in its methods. The statement has been made that investigation only becomes scientific when it becomes quantitative. This seems to me to be a narrow point of view which partakes somewhat of intellectual snobbishness. This attitude, however, is not universal, it is even rejected by many whose own methods are the most exact and quantitative. Professor Gilbert Lewis has recently said, "I have no patience with attempts to identify science with measurement, which is but one of its tools, or with any definition of the scientist which would exclude a Darwin, a Pasteur, or a Kekulé." One may add a Harvey, a Mendel, a Virchow and many others. Another writer states, "It savours of what we may call scientific Chauvinism to maintain that the physicochemical interpretations, when they go to the formation of our outlook on nature, require no correction from the biological, mental and social sciences. It requires a long-necked observer to see the whole firmament out of one window." That biology is not as exact as physics or chemistry is related in part to the fact that the phenomena studied do not occur in a simple system, the complexity of the environment in which these phenomena take place, even in the simplest unicellular organism, seems bewildering. Moreover, compared with astronomy and physics, biology is a young science, and only in very recent years has the experimental method been seriously applied to the solution of its problems.

Another point of view which seems to me misleading is the frequent reference to medical science as an applied science. In this designation the assumption is made that it is "oriented in relation to the art of healing." It is true that this has largely been the case in the past and this, I feel, is one of the reasons why even greater progress has not been made in the development of this branch of knowledge. It must be admitted that many of the great discoveries in medicine have been largely empirical. This does not minimize their importance either to science or to humanity. But, in a constantly increasing degree, knowledge in this field is unfolding through the conscious employment of the experimental method, using the discoveries and laws of the basic sciences as stepping stones. It is this that justifies the belief that, in the future, progress in this branch of science will be even more rapid than that which has occurred in recent decades

Since pathology is a young science, barely in its infancy, accurate observation must of necessity occupy an important part in the activities of its devotees. Indeed, the first step in the study of any science is the observation and description of natural phenomena. Only by this means do we come to have knowledge of what we want to explain. All the sciences, except mathematics, are concrete, in that they deal with what actually happens. There is little point in studying with scientific methods that which "never was on sea or land." It would be my last wish to minimize the importance of the poet, but his ways are not the ways of the scientific observer. Apollo was worshipped not only as the god of medicine, the father of Aesculapius, but also as the god of poetry, music and art, and doctors have always had a propensity to philander with the muses, yet the student of scientific medicine, as the student of every other science, when he is playing the part of an observer, must place a guard over his emotions and, face to face with Nature, must try to see straight. Included in observation is classification, which method has been, and always will be, important in making our observations workable. But accurate observation is not sufficient. "How" and "why" are bound to intrude and must become insistent if knowledge is to grow. In trying to answer these questions the student may now loosen the leash upon his imagination. He may even listen to "the bluebird singing of beautiful and impossible things, of things that are lovely and that never happen, of things that are not and should be." In this stage of the process of discovery the greater the student's power of making unusual and new combinations and the greater his ability to visualize his previous observations in a new light, the more likely is his chance of success. But the scientist and also the physician must keep his reason and his emotions in separate compartments. In selecting which hypothesis he shall try, as he can not try them all, he must again

lock up his imagination and call on reason to aid him. In the light of accumulated knowledge, is this or that hypothesis likely to be the right one? Then comes the doing, the performance of the actual experiment, and again there must be accurate observation, for without this the test will be worthless

For all these procedures of observation and testing, the student of science, be it physics or medicine, must have a workshop, that is a laboratory And these workshops to-day must be elaborate and costly affairs When science was younger and when the chief interest lay in those branches of physics where conditions could be easily controlled, as in the science of mechanics, laboratories belonged to the individual. But, as the sciences developed, more elaborate equipment became necessary and the providing of laboratories became a communal obligation, a function of the state or of the university. To-day the university laboratories, even those of physics, have become elaborate affairs, equipped with powerful engines and motors, as well as with the most delicate and finely adjusted instruments. An air-pump and an inclined plane no longer suffice for the needs of the physicist This development of university laboratories has occurred with astounding rapidity. Until the early part of the last century the only university laboratories worthy of the name were those of anatomy—laboratories for observation and description It was only about one hundred years ago that the first university physiological and chemical laboratories were established, that of Purkinje, at Breslau, in 1823, and that of Liebig, at Giessen, in 1824. It was even later, in 1845, that the first university laboratory of physics was established by William Thomson, later Lord Kelvin, at the University of Glasgow. Astronomical laboratories are probably the oldest laboratories of all, for man's first wondering gaze apparently fell upon the heavens, certainly long before he became inquisitive about his fellow man. There is evidence that an observatory existed at Alexandria 300 B. C. Because of the importance of astronomy in navigation, for many years observatories were erected and supported chiefly by the state, though the study of the stars has always been a favorite avocation of the rich and noble and they erected observatories for their own use and that of their scientific protégés At the end of the eighteenth century, however, observatories began to be established in universities, the Radcliffe Observatory at Oxford, presented by the London physician, John Radcliffe, being founded in 1771. The Harvard Observatory was established only in 1847.

From the time that President Harper accepted the presidency of this university and understood its organization, he emphasized the importance of laboratories. It is not surprising, therefore, that a week after the university began to admit students the announcement was made of a gift which enabled the university to erect and equip the most complete astronomical observatory then existing in the world. With the development of the university there were established in rapid succession the wonderful laboratories that have been the envy of most other institutions of learning.

While it required many years for the universities to recognize the importance of, and to establish, observatories where natural phenomena could be observed and in which experimental studies could be made, it has required a still longer time for the universities to recognize the importance of establishing their own hospitals, that is observatories, where human disease, as it occurs under natural conditions, can be carefully and accurately observed, and also their own laboratories of medicine where experimental studies concerning disease may be conducted. It is true that in Germany many so-called university hospitals exist but in most cases these are but municipal or state institutions, more or less under university control In this country also certain state hospitals have had a close affiliation with the university, but, so far as I know, this is the first hospital erected on the campus by a university with the analogy of the hospital and laboratory clearly in mind

In the past there has been a trace of the repugnant in the conception of a hospital as a laboratory. Hospitals were originally founded, as the name indicates, to provide hospitality to the poor and decrepit; only later did they become institutions for the care and treatment of the sick Our most tender and gentle emotions are connected with the idea of ministering unto those suffering from disease. To expose our loved ones to the gaze, and especially the inquisitive gaze, of strangers has seemed cruel and harsh. It is unnecessary here to dwell on the change which has taken place within recent years in the attitude of the public toward the hospital. With the development and growth of modern scientific medicine and with the general recognition of the great blessings which it has bestowed, the dread of entering hospitals and the reluctance to send our friends into them have largely disappeared. The rich, as well as the poor, the powerful and influential, as well as the weak and obscure, are rushing to fill our hospital beds, until society has become unable to supply the demands. Moreover, it has come to be recognized that the best care will be obtained where the observation of patients is the most painstaking and accurate. There is, therefore, no longer any reason why the hospital should not be spoken of as an observatory in which

the sick are observed, studied and treated. The hospital is the observatory of the department of medicine. It, of course, must also continue to be the dispenser of hospitality, and it would be a sad day for both scientific and practical medicine if this were ever forgotten. Observation must include not only seeing the sick with our naked eyes, it must be done with the aid, not of powerful telescopes and lenses, but with all the instruments of precision which the other sciences have furnished.

Even this, however, is not sufficient for the university department of medicine if it is to perform its proper function. The student of disease must be constantly seeking for new knowledge that can not be obtained by observation alone. He must employ the other steps in the method of experimentation. This does not mean that patients must be the subjects for experiment—far from it. In my experience the application of new and untried measures to patients in any hospital is in inverse ratio to the scientific atmosphere there existing. It is only in hospitals directed by the ignorant and by charlatans that unusual and untested measures are employed. Indeed, one important purpose of the experimental laboratory is to make certain that any measures to be applied to patients will be helpful and not harmful. The scientific observer of disease does no more harm to his patient than the astronomer does to the stars when he directs his gaze upon them through the telescope. When necessary, experimental studies must be made on animals, under proper conditions to avoid unnecessary pain. But in most of the experimental work in the laboratory of medicine the materials used are not animals, but they are bacteria and excretory fluids, and the instruments used are not knives and trephines, but microscopes and chemical reagents. It is this very inability to modify conditions in his field of observation that makes the work of the student of disease so difficult, just as it does that of the astronomer. The student of disease, as the student in the other branches of biological science, must bring to his aid the methods of the more fundamental sciences, physics and chemistry and physical chemistry, and even employ the methods of mathematics. There can be no doubt concerning the importance of the application of the methods and the contents of these sciences in the study of disease, but in these days of rapid progress we must be on our guard not to be over-fascinated by the prospect which the mere application of the methods of these sciences holds forth. We shall do well to remember the fate of the iatro-chemical and the iatro-physical schools of medicine which flourished in the seventeenth century, in another period of great activity in the physical sciences. The chief result of the foolish pretensions of these schools was the cry "Back to Hippocrates" and a turning of the doctors to Sydenham for guidance. We should remember that, while the contributions of Borelli and van Helmont have had no permanent influence on medical progress, Sydenham is still a living force. Newer concepts like that of emergent evolution give some support to the biologists who hold that there is something more in biological phenomena than the mere manifestations of energy working according to the laws of physics and chemistry that are already known. We sometimes forget that very few of these so-called laws have been discovered and that they are but imperfectly understood. Moreover, our faith in the immutability of some of the most cherished ones has recently been rudely disturbed. An important scientist, Whitehead, has recently said, "Science is taking on a new aspect which is neither purely physical, nor purely biological. It is becoming the study of organisms. Biology is the study of the larger organisms, whereas physics is the study of the smaller organisms." Furthermore, he says, "no one doubts that in some sense living things are different from lifeless things." Let us as biologists and as students of disease be not too modest, ashamed of our problems and our methods. Above all, let us not forget that we have our own problems. Progress is never made by waiting for an explanation of all the details before going ahead. Columbus did not wait for a map of the ocean currents, nor did Lindbergh wait for a chart of those of the air.

In the department of medicine the student should never forget that he is studying disease. In order to make progress he may need to go far afield, since the other sciences may not furnish him the methods or the necessary knowledge to make the next step, but the main problem should always be in the background of his consciousness. Otherwise he would probably better be working in the laboratory of physics or chemistry or physiology. None of those working in the domain of science may stake out preserves. Each worker is bound to be led into his neighbor's field and it is in these wanderings that the best game is usually bagged. But each one, and especially the worker in the department of medicine, should always remember where his home lies. He can never forget this if he has contact with patients in the hospital. He must not forget it if the university department of medicine is to justify its existence.

It is obvious that in the organization and equipment of a department of medicine, the university is confronted with an enormous task, not only in supplying the material resources needed for the hospital and various laboratories but in obtaining men who

are properly equipped for the work to be done. In some places the attempt has been made to avoid some of the difficulties by divorcing experiment from observation, by establishing a department of experimental medicine separate from the department of clinical medicine in which study can be made only by means of observation. That progress can be made by observation alone, the history of science abundantly indicates. Hypothesis may follow observation and confirmation or rejection of the hypothesis may come through repeated observations. Indeed, with a sufficient number of observations, possibly even general laws might be deduced without the formulation of any hypothesis whatever. But that has not been the history of scientific advancement. Observation alone makes the road to knowledge long and tedious. The introduction of experimentation provided the needed short cut. On the other hand, many of the advances in recent years have been made by men whose only contact with human disease has been through their own afflictions. The importance of the contributions to our knowledge of disease made by physiologists, by chemists, by physicists, and by those working with disease experimentally induced in animals has been enormous and it is hoped and believed that these contributions will be continued in ever-increasing number. However, the complete separation of the observation of disease, as it occurs naturally, from the more intensive and experimental study seems neither rational nor advisable. It is impossible to reproduce human diseases accurately in animals. Conditions very like those occurring naturally in man may be produced in animals but there is always a difference, very often an important one. Through contact with human disease the imagination is stimulated, placing various observations in juxtaposition gives rise to new ideas, hypotheses develop. These hypotheses, however, will be of value only if they are not mere vain imaginings but if they can be put to the test by the individual making them. The opportunity for testing stimulates the formulation of ideas, in other words it develops the scientific, the experimental attitude of mind. From the educational standpoint this is most important of all. Many of the students in this department will become practitioners of medicine. Whether engaged in the practice of medicine or in investigation the scientific attitude of mind is essential. If this or any other university can cultivate in its students the desire to learn what is unknown, it will probably have solved the educational problem, provided, of course, the student is willing to spend the time and effort necessary to obtain the training required for fulfilling his desires. If one may paraphrase, "we do but go where *curiosity* leads the way."

But not all the students in this department will become practitioners of medicine. Some will become teachers, others will engage in public health activities, in which a knowledge of disease is of first importance. A few, and probably a constantly increasing number, will engage in the study of disease simply because it is a subject of extraordinary interest and because of its importance in the formulation of general biological principles. Some will become investigators of disease because of their desire to prevent suffering and to promote human welfare. With the accumulation of wealth in this country there will undoubtedly be an ever-increasing number of men and women who are relieved of financial burdens. In the past these men and women have become artists, explorers, writers. What is more fitting in this "Age of Experiment" than that some of these persons should become scientists, and what more interesting field in science can there be than the study of disease? In what way can these men and women be more useful to humanity? The university, however, must see to it that these opportunities are not limited to those financially independent. As Professor Huxley has said, "It is given to the few to add to the store of knowledge, to strike new springs of thought, or to shape new forms of beauty. But so sure as it is that men live not by bread, but by ideas, so sure is it that the future of the world lies in the hands of those who are able to carry the interpretation of nature a step further than their predecessors, so certain is it that the highest function of a university is to seek out these men, cherish them, and give their ability to serve their kind full play."

I congratulate this university that it has had benefactors of such generosity and wisdom as to establish and endow this hospital and clinic and department of medicine. I congratulate these donors for the opportunity which has been granted to them to perform so great a service to learning and to humanity. All that is possible has been done in preparation to provide hospitality and comfort for the sick, to relieve their ailments and to provide for their esthetic and spiritual needs, laboratories and equipment have been supplied so that patients suffering from disease may be studied in order that light may be shed on all that is mysterious and obscure; provision has been made for applying all that is known to relieve pain and distress and to save life, but, more important than all, provision has been made for investigation, so that more may be known concerning disease and its cure. This is not merely the dedication of a new hospital for the people of Chicago, or of the State of Illinois. It is a world institution; its influence will be felt wherever sickness and suffering exist. Other hospitals and other institutions have made advances

in this direction The University of Chicago has consciously inaugurated a new idea, it has established a true university department of medicine, it has erected an observatory and laboratory for the study of disease.

Rufus Cole

Hospital of the
Rockefeller Institute,
New York City

THE BIOLOGY OF LAKE BAIKAL

My wife and I have just returned to Irkutsk from a most interesting trip to Lake Baikal and Archan. We went first to the Biological Station of the University of Irkutsk, on the shore of the lake, some distance north of the village of Listvenitschnoe It was our good fortune to be accompanied by Mr. W. Jasnitsky, of the botanical department of the university, who is working at the station and has charge of its affairs at the present time Leaving Irkutsk, we went on the train to Baikal, a station at the beginning of the great and swift Angara River, which flows out of the lake. Taking the ferry across the Angara we were met by a boat in which we were rowed to the station, a journey of several hours It was after dark when we saw a faint light across the waters, and presently came to a log house with several rooms, in which teachers and students live, and the work is carried on. Although the resources of the station are pitifully small, and would be considered quite inadequate in most countries, the group working there is a happy one and is doing work of great value The surroundings are charming, with meadows full of flowers and hills covered with trees in the background. Across the lake at a distance of 40 or 50 kilom, but seeming much nearer, are the great Transbaikal Mountains The water of the lake is usually calm in morning and evening, but more or less disturbed during the middle of the day. Occasionally there are storms so severe that it is impossible to land from a boat. The principal work going on at the time of our visit was that of W Jasnitsky on algae and plankton; M M. Kojoff on the Baikal fauna and especially the spermatogenesis of the snail *Benedictia baicalensis*, Ivan Rubtzoff on planarians, of which he has discovered several new species, one of which is oviparous; W. W. Jzossimoff (of Kazan University) on general hydrobiology, and especially oligochaetes and water-mites, Nina A Epoff on the flowering plants of the vicinity; N M. Wlassenko on the parasitic worms of fishes, Galia A. Muromoffa (University of Tomsk) on the plankton of littoral zone; Lidia A Wasilewskaia on the plants of a defined area In addition to these, a house close by is occupied by Professor Dorogostaiski, who has charge of the establishment for breeding useful native animals, deer, foxes, sables, squirrels, etc. Some of the foxes are Siberian, others from Alaska. The deer are from the Maritime Province, and were only recently received. The professor is an all round zoologist and has published a very important work on the amphipod crustacea of the lake. He showed me the exquisite colored drawings for a new paper on the amphipods, with many new species, to be published by the Academy of Sciences at Leningrad next year. In spite of the limited resources, there are enough facilities for good work and the good fellowship and romantic surroundings give the place an indescribable charm, accentuated by the sense of peace and remoteness from the troubles of the world It is an unfortunate circumstance that the authors of the resulting papers have to pay about half the cost of printing, except in the case of specially interesting work, when assistance may be obtained from Moscow, or of course in the rare case of papers published by the Academy of Sciences at Leningrad.

Leaving the university station, we next visited the establishment of the Russian Academy of Sciences, situated at Maritue, south or rather east of the Angara We were very fortunate in finding there Professor Nassonov, whom I was especially pleased to meet, as I used to correspond with him about Coccidae in the days before the war. Professor Nassonov explained that the house at Maritue was not to be regarded as a biological station, but only as a base for the Baikal expeditions sent out by the Academy At the moment there were three parties working in North Baikal—a botanical one under Professor Mayer; one on fish and fish breeding, and chemical analysis of water, under Professor Soldatoff; and the third on general zoology, but principally Cladocera, under Verschagen. They have a motor boat, which enables them to reach distant parts of the lake. Nassonov himself had just returned from an expedition and was about to leave for Leningrad. He gave me some very fine and large amphipods, which I shall send to the U S. National Museum, as Miss Rathbun tells me they have none of the Baikal crustacea. The Academy has in view the establishment of a larger and permanent station, at Tanhoe or Mysovsk, preferably the latter because of the great depth of water nearby. Both are on the transsiberian railway, as is Maritue.

The more we study the Baikal problem, the more evident does it become that it includes matters of the greatest interest for biological theory. In spite of the unexplained presence of the seals (*Phoca foetida sibirica* Gmelin), which are said to be nearest related to the Caspian form, the marine elements which figure so largely in many discussions are evanescent. The nudibranch, the pteropod and the nemertean

are doubtful and can not be confirmed. The nudibranch was found in a bottle labeled Baikal, but probably never came from the lake, as no traces of it can be found at the present time. The large sponge *Veluspa baicalensis*, which I found washed up on the shore and also saw dredged, is suggestive of marine relationships. The copepod *Harpacticella* and the amphipod *Gammaracanthus* are also cited in the same connection The seal does not help the theory of marine origin, as such origin must date far back of the evolution of the species *Phoca foetida*, or indeed presumably of the genus Phoca Supposing there to have been connection with the sea, some have imagined it to be by way of the Caspian, others have suggested the Arctic Ocean Professor Nassonov thinks rather that the Sea of Japan holds the key to the understanding of the origin of Baikal. He has found a new genus of Rhabdocoelida, with several species in Lake Baikal, and a marine species on the coast of the Maritime Province, not far north of Korea Professor Dorogostaiski, I understand, believes that whatever may have been the origin of the lake, its fauna was at a remote period reduced to a few species, and when conditions became favorable these evolved into many, in the absence of competition Thus the case would parallel that of the Hawaiian Islands, which were populated by a small number of insect and mollusc types, accidentally carried over sea These groups have in the islands given rise to vast numbers of species, so that while the genera are few, the species are very many On continental areas the potential species-making ability of a genus can not be realized, most of the possible forms being cut off in the struggle for existence There are good reasons for thinking that the parallel here suggested is not fanciful, and thus the Baikal biota acquires a new interest This phenomenon of species-multiplication is probably connected with mutations or changes in chromosome numbers. It will be of extraordinary interest to study the chromosomes of the amphipods, planarians, etc, and see if they exhibit the phenomena of polyploidy

Baikal appears to be the deepest lake in the world, with a maximum depth of about 1,560 meters The water is very cold, and saturated with oxygen, the oxygen content being even greater than that of the small streams flowing into it The water is fresh, with very little mineral matter in solution, and as a consequence the shells of the mollusca are very thin Thus the conditions are quite unique, and it is not surprising that the fauna is peculiar. When I went down to the shore I expected to see some of the peculiar water-snails, but there are none along the water's edge, where snails would be expected in other places. A little later the dredge was used in a few fathoms, and many snails, planarians and amphipods were brought up. It was very interesting to see *Benedictia baicalensis* alive; the head, tentacles and body above black, but the sole grey. When the dredge brings up such a variety of molluscs, planarians, etc, all attached to the same stones, one gets the impression that species-formation has gone on without diversification of conditions and special adaptations. Nevertheless, there are many species showing special adaptations Thus the snails of the genus *Benedictia* present a series of species at various depths, those of the lowest zone (*B fragilis*) being very large, with very thin shells Similarly the deep-water amphipods show special characters, as pale coloration and long appendages. Some of the deep water amphipods come to the surface at night, and while I was at the station I saw a living *Macrohectopus branickii* (Dybowski), a very translucent species, taken in the plankton the night before It regularly inhabits a depth of 300 meters The fauna of the lake includes the following Mammalia, the seal, of an endemic subspecies; fishes, about 34 species, with an endemic family, and seven genera and 17 species endemic, gammarid crustacea, over 300 species now known, and new ones still being found, all endemic except the common *Gammarus pulex*, Branchiopoda, 12, not endemic, Copepoda, 11 recorded, a few endemic, these and other small crustacea not yet well known, Gastropod mollusca, about 75 species, of which 68 endemic, with several endemic genera, and the family Baicaliidae, Lamellibranch mollusca, 15 species, of which 13 endemic; Planarian worms, over 100 species now known, all endemic (only about 50 species in all Europe!), new ones constantly found, Oligochaetes, over 30, nearly all endemic, with five endemic genera, Rhabdocoelida, shortly to be described by Professor Nassonov, who tells me that all the species of Baikal are positively heliotropic, while all those of other lakes are negatively heliotropic, efforts were made on a small scale to transfer the animals to other waters, but they died, *Gordius* (a specimen was brought in while I was talking to Professor Nassonov; he said it was the first record for Baikal); Bryozoa, three recorded, one endemic, sponges, 10, of which eight endemic and one endemic genus; Protozoa, not yet fully investigated, but proving extremely interesting Professor Swartschewski, of Irkutsk, has been working on the suctoria commensal on amphipods, and in about three months has found about 50 peculiar species At Maritue I met Miss Z I Senilova, of Moscow, who was working on the Infusoria. She mentioned the peculiar fact that Baikal was now full of a probably new species, which last year she could not find at all. The recorded Rhizopods are ordinary, but Professor Sche-

wiskoff, of Irkutsk, has taken up the study of this group, and important results may be confidently expected The Tardigrade genus *Macrobiotus* occurs in the lake The recorded algae are numerous, about 170 species, including a number of endemic *Draparnaldia*. A microscopic alga parasitic on mosquito larvae was described last year by Jasnitski. There is a recently described endemic *Hydra*.

The biota of the region around the lake is purely Palaearctic. The flowering plants include such genera as *Rhododendron, Cotoneaster, Rosa, Rubus, Pedicularis, Parnassia, Papaver, Aconitum, Polemonium, Spiraea, Alnus, Polygala, Scutellaria, Lamium, Ranunculus, Veratrum, Silene, Myosotis, Zygadenus, Geranium, Thalictrum, Chrysanthemum, Linaria, Centaurea, Sedum, Agrimonia, Stellaria, Campanula*, etc *Potentilla fruticosa* and *Epilobium angustifolium* are abundant, and quite the same as we get in America. A common tall labiate with pink flowers is *Phlomis tuberosa*; I found also a form *albiflora*, with pure white flowers. Land snails are very few in all this region, the only peculiar one I found is apparently the *Eulota asiatica* Dybowski, described as a variety of the European *E. fruticum* The scarcity of snails may be due to the fact that after the ice age no migration was possible from the south, the Gobi desert intervening

T. D A Cockerell

Geological Committee, Irkutsk, Siberia,
August 17

SCIENTIFIC EVENTS

MEMORIAL OF PROFESSOR BRUCE FINK

The committee of the university senate of Miami University, appointed by President Brandon to prepare a statement for the senate record in memory of Professor Bruce Fink, submits the following

Early on the morning of July 10, 1927, Professor Fink died just after entering his laboratory

He was born in the village of Blackberry, Illinois, December 22, 1861 He was graduated from the University of Illinois in 1887, and received the degree of M S. in 1894 He continued his graduate work at Harvard University as a Townsend scholar, where the degree of A.M was conferred upon him in 1896. His work was completed for a doctorate at the University of Minnesota in 1899 He studied at the University of Chicago in 1903 From 1887–92 he was engaged in secondary education, from 1892–1903, professor of biology in Upper Iowa University, from 1903–06, professor of botany, Grinnell College, and from 1906 to the time of his death, professor of botany, Miami University.

A partial list of his activities outside of the immediate conduct of his department indicates his wide general interest in promoting botanical research and something of his standing among his fellow botanists. He took part in a botanical survey of Minnesota, 1896–02; was in charge of botanical studies at the Marine Biological Station, Puget Sound, Washington, 1906, and was associate editor of *Mycologia* from 1908 on. He was a fellow of the American Association for the Advancement of Science, member of the American Society of Naturalists, of Botanical Society of America, of the Botanical Society of the Central States, the Sullivant Moss Society president, 1910 His leadership in scientific circles was recognized by becoming president of Iowa Academy of Science in 1904, and of the Ohio Academy of Science in 1912

His productive work as a scientist is indicated by the long list of titles of his publications—more than one hundred, mainly relating to lichens. During his study of these plants he amassed a large collection of some 15,000 specimens, one of the most complete in this country He was generally recognized as the leading American lichenist and one of the two greatest in the world At the time of his death he was bringing together the results of his long research in the form of a monograph, "The Lichens of the United States" His work was so far advanced that it will be possible to complete it essentially as he had planned to do himself

He was much interested in young people and helped them in many ways. He was an especially keen judge of ability in students and was able in many instances to encourage individuals of promise to enter the field of science as a life career. More students went into graduate work from his department than from any other in the university Among these many have become leaders in various fields of botanical research

As a citizen he had a high sense of civic responsibility, and was active in many enterprises promoting community welfare or adding beauty to its environment. He was always interested in public affairs, was well informed on political questions, both state and national

His passing leaves a vacant place in our university group, one that will not soon be filled As a colleague he will be long remembered for his genial fellowship and fine spirit of cooperation Many of the younger members of the faculty will recall the cordial interest he showed towards their problems and ambitions. All the older members will preserve the memory of his unfailing friendship

B M. Davis, *Chairman*
S. R Williams
C H. Handschin
F. L. Clark
W. H Shideler

THE THIRD RACE BETTERMENT CONFERENCE

Preliminary announcement of the Third Race Betterment Conference, the first to be held since the war, has been made by Dr. C. C. Little, president of the University of Michigan, who heads the conference committee.

The two-fold object of the forthcoming conference, which will be held at Battle Creek from January 2

to 6, is first to assemble the facts of race degeneracy and also of recent scientific progress dealing with the prolongation of human life, and second to give a greater impetus to the dissemination of these facts for the benefit of humanity. Special group sessions will be given over to reports of recent progress in the field of bacteriology, medicine, nutrition, eugenics, physiology and education

The conference is being organized under the auspices of the Race Betterment Foundation, the founder and president of which is Dr. John Harvey Kellogg, and which sponsored the first and second conferences held in 1914 and 1915 at Battle Creek and at the Panama Pacific Exposition in San Francisco The Battle Creek Sanitarium will act as host for the January conference

Delegates will be present from many research laboratories, including the Rockefeller Institute for Medical Research, the Sheffield Scientific School, the Eugenics Record Office of the Carnegie Institution, Cornell University Medical College, the Universities of Chicago, the Johns Hopkins, Harvard, Yale, Northwestern, Wisconsin, etc

Among the speakers announced are the following: Miss Grace Abbott, chief of the Children's Bureau, U S Department of Labor, Washington, D C, Dr Herman N. Bundesen, city health commissioner, Chicago, president of the American Health Association; Dr Anton J. Carlson, chairman of the department of physiology of the University of Chicago, Dr Alexis Carrel, Rockefeller Institute for Medical Research; Professor Russell H Chittenden, Sheffield Scientific School, Yale University, Dr. C. B Davenport, Carnegie Institution of Washington, Cold Spring Harbor, N Y.; the Honorable J J Davis, secretary of labor, Washington, D C; Dr. Irving Fisher, professor of political economy in Yale University, Dr. Glenn Frank, president of the University of Wisconsin; Professor J. W Glover, professor of mathematics and insurance in the University of Michigan; Professor M. F. Guyer, professor of zoology in the University of Wisconsin, Dr. Louis I Harris, New York city health commissioner; Charles Holmes Herty, adviser to the Chemical Foundation, Inc, Major-General M. W. Ireland, surgeon-general U S Army; the Honorable Albert Johnson, chairman of the committee on immigration and naturalization, House of Representatives; Professor E. O. Jordan, chairman of the department of hygiene and bacteriology of the University of Chicago; Professor Charles H. Judd, director of the School of Education, University of Chicago; Dr Vernon Kellogg, permanent secretary of the National Research Council; Dr. Arthur I. Kendall, dean of the biological department, Northwestern University Medical School; Dr. Franklin H. Martin, director-general of the American College of Surgeons and director of the Gorgas Memorial Institute, Chicago; Dr Max Mason, president of the University of Chicago; Professor E. V. McCollum, School of Hygiene and Public Health, the Johns Hopkins University, Professor Edward Alsworth Ross, professor of sociology, University of Wisconsin; Dr. Walter Dill Scott, president of Northwestern University, Dr George David Stewart, president of the American College of Surgeons, New York City; Dr. John Sundwall, professor of hygiene and public health of the University of Michigan, Dr. Aldred Scott Warthin, president of the National Association of American Physicians and director of the pathological laboratory of the University of Michigan, and Dr. Harvey W. Wiley, Washington, D C

OPENING OF THE NICHOLS CHEMISTRY BUILDING AT NEW YORK UNIVERSITY

The Nichols Chemistry Building of New York University was opened on the afternoon of December 3 Dr William H Nichols, a graduate of the university, now a member of the council, gave $600,000 for the erection of the building Among those who gave addresses are Dr Arthur B Lamb, professor of chemistry at Harvard University, Dr Arthur E Hill, professor of chemistry at New York University, and Dr. James Kendall, professor of chemistry and dean of the graduate school of the university

Dr. William H Nichols, a graduate of the university college of arts and pure science of New York University in the class of 1870 and a member of the council of New York University, who in 1925 donated the sum of $600,000 for the erection of the building, and Mrs Nichols were present at the ceremonies Dr Nichols formally presented the building and Chancellor Elmer Ellsworth Brown accepted the gift on the part of the university Mrs Nichols unveiled the memorial tablet.

The Nichols Chemistry Building greatly enlarges facilities for the teaching and laboratory work in chemistry at the university, which previous to the erection of the new building was carried on in the Havemeyer laboratory, which has now been turned over to the department of biology for research work.

The new building is a rectangular structure 210 feet long by 60 feet wide, located on the south side of the fifty-acre campus at University Heights It is so constructed as to have four stories and a basement above ground, with an attic for mechanical installation purposes. It contains approximately 1,000,000 cubic feet of floor space and over 60,000 square feet is being devoted to laboratories and lecture rooms.

The building, designed by Augustus N. Allen, is one of the largest buildings in the country entirely

devoted to the study of chemistry. It contains space for large chemical engineering laboratories, which have been fitted up with apparatus for teaching the unit processes in chemical industries. Provision has also been made for laboratories for undergraduate study in organic, inorganic, quantitative and qualitative analysis and physical chemistry. These laboratories will accommodate about 1,300 undergraduate students

In addition to the laboratories there are three large lecture rooms, an auditorium seating over two hundred and fifty people and four classrooms The fourth floor is given over to research laboratories for members of the faculty and graduate students. There are in all twenty-five laboratories in the building and each can adequately accommodate several investigators The Loeb library of chemistry is on the fourth floor. This library was founded by the late Solomon Loeb, of the banking firm of Kuhn-Loeb and Company

SCIENTIFIC NOTES AND NEWS

DR IRVING LANGMUIR, of the General Electric Company, Schenectady, N. Y., has been awarded the Perkin Medal for 1928. The presentation will be made on January 13

DR. ARTHUR H. COMPTON, professor of physics at the University of Chicago, who was recently named as cowinner of the 1927 Nobel prize in physics, has left Chicago for Stockholm, where he will receive the prize on December 10, and will deliver the Nobel lecture on "X-Rays as a Branch of Optics" He will return to the university on January 1 to resume his work. On November 28 Professor Compton was the guest of honor at a dinner and celebration at the College of Wooster, from which he graduated in 1913. Professor Dayton C Miller, of the Case School of Applied Science, Cleveland, Ohio, was the representative of the American Association for the Advancement of Science at this celebration.

THE honorary degree of doctor of science was conferred on M Paul Painlevé, professor of analytical and celestial mechanics at the Sorbonne and French Minister for War, by the University of Cambridge on November 16. In the afternoon of the same day M. Painlevé lectured in the Arts Schools on "Resistances d'un liquide au mouvement d'un solide"

THE following is a list of those elected to the council of the Royal Society at the anniversary meeting on November 30. *President,* Sir Ernest Rutherford; *treasurer,* Sir David Prain; *secretaries,* Mr J H. Jeans and Dr H H Dale, *foreign secretary,* Sir Richard Glazebrook, *other members of council,* Dr. E. D Adrian, Sir Hugh Anderson, Dr. F. W. Aston, Dr. F. A. Bather, Sir Archibald Garrod, Sir Thomas Heath, Professor A. Lapworth, Professor J C. G. Ledingham, Professor F. A. Lindemann, Mr. J. E. Littlewood, Mr C Tate Regan, Professor A. C. Seward, Professor G. Eliot Smith, Dr. T. E Stanton, Sir Gilbert Walker, Sir James Walker

AT a meeting of Delta Omega, the national honorary public health society, on October 19, C.-E A. Winslow, Anna M R Lauder professor of public health at Yale University, was elected president Major Edgar E Hume, U S. Army, vice-president, and Dr James A Tobey, New York, secretary. Chapters of the society have been established at the Johns Hopkins University School of Hygiene and Public Health, the Harvard University School of Public Health, the National Institute of Technology, Yale University School of Medicine, the University of Michigan and the University of California

DR F BAKER has been appointed honorary curator of mollusks at the Scripps Institution of Oceanography, La Jolla.

DEAN JOHN N COBB, of the University of Washington College of Fisheries, has been appointed to the economic division of the United States Fisheries Association

DR. H. E BARNARD has resigned as president of the American Institute of Baking

THE portrait of Professor J A. Fleming was presented to University College, London, on November 30. Professor Fleming was also presented with a copy of the portrait, and he has intimated his intention of presenting this copy to the British Institution of Electrical Engineers.

PROFESSOR R. B. WILD, who retired in September from the Leech chair of materia medica and therapeutics in the University of Manchester, was presented on November 11 with his portrait and other gifts. The presentation was made by Professor G. R. Murray, on behalf of Professor Wild's past and present colleagues in the faculty of medicine, in appreciation of the valuable services he has rendered to the cause of medicine and education in Manchester In accepting the gifts Professor Wild expressed a desire that the portrait should be given to the university, and the vice-chancellor accepted the offer.

THE resignation of Professor E C. Williams from the Ramsay chair of chemical engineering, tenable at University College, London, has been accepted as from the end of the present academic year.

DR. JAMES M. ANDERS celebrated his fiftieth anniversary in the medical profession on November 28, when he was honored by his friends at a testimonial dinner in the Bellevue-Stratford Hotel. Dr. Josiah H.

Penniman, provost of the University of Pennsylvania, presided. A life-size bust of Dr. Anders was presented to him by Dr. John B Deaver. At the dinner the speakers were Dr. George L. Omwake, president of Ursinus College, Dr. Judson Daland, professor of medicine in the graduate school of the University of Pennsylvania, Dr. Llewellyn Barker, emeritus professor of medicine at the Johns Hopkins University; Dr Hobart A. Hare, professor of therapeutics, materia medica and diagnosis at Jefferson Medical College; Dr. David Riesman, professor of clinical medicine at the University of Pennsylvania, and Franklin Spencer Edmonds, who represented the legal profession

DR. LOUIS F JERMAIN, dean emeritus, director and professor of the department of internal medicine, Marquette University School of Medicine, Milwaukee, was recently honored at a testimonial dinner given by the faculty and students, and by the bestowal of a golden key commemorating his years of service to the university The address on this occasion was made by Dr Eben J Carey, acting dean and professor in the department of anatomy.

DR. THOMAS BARBOUR, who was recently appointed director of the Harvard University Museum, has resigned as president of the Boston Society of Natural History.

BECAUSE it will be impossible for him to be in attendance throughout the week of the approaching Nashville meeting, Dr Roger Adams, of the University of Illinois, has resigned from the committee on award of the Nashville prize of the American Association (See SCIENCE for November 25, 1927, page 511.) Dr G Canby Robinson, dean of the Medical School of Vanderbilt University, has been named to fill the vacancy. The committee consequently consists of William H. Roever, William Duane, G. Canby Robinson, Charles Schuchert and Robert J. Terry.

DR. W. C. AUSTIN has recently been appointed a research associate in the sugar section of the U. S Bureau of Standards, having been granted a fellowship by the Medical Fellowship Board of the National Research Council.

DR. ROBERT F. MEHL has been appointed director of the Naval Research Laboratory.

DR. ROBERT J. PIERSOL, formerly research physicist with the Westinghouse Engineering and Manufacturing Company, is now a consulting physicist with offices in Pittsburgh.

DR. JOHN PHILLIPS, formerly director of the Forest Research Station at Deepwalls, Knysna, South Africa, has accepted the post of senior botanist under the Colonial Office of the Imperial Government to assist in the research on the tsetse fly carried on under the direction of Mr C F M Swinnerton in the Tanganyika Territory His work will be to study ecologically the habits and habitats of the various species of *Glossina*, in relation to methods of combating the tsetse fly. After the middle of December he will be at the Department of Game Preservation, Kondoa-Irangi, Tanganyika Territory, Africa.

ROBIN JOHN TILLYARD, entomologist and chief of the biological department of the Cawthron Institute, Nelson, N. Z, has been appointed to take charge of entomological investigations under the Australian Council of Scientific Research

DR. E C. WILLIAMS, professor of chemical engineering in University College, London, has been appointed to establish a research organization in California for the Dutch-Shell oil interests

IN connection with his studies of the flora of Central America, Paul C. Standley, associate curator of plants at the U S National Museum, left New York for Honduras, on November 26, for the purpose of conducting botanical exploration in that country for a period of about four months.

DR. I F MOLL, of Berlin, recently spent a week studying the collection of shipworms in the U S. National Museum prior to preparing a monograph on the structure of the pallets of the group.

PROFESSOR OTTO AICHEL, head of the department of anthropology at the University of Kiel, has undertaken a research expedition to Chile. Later he will go to Peru and Bolivia.

ARTHUR S VERNAY, who with Colonel J. C. Faunthorpe has provided a rare series of specimens of Indian mammals for the American Museum of Natural History, sailed on November 24 on another expedition in the interest of the museum. With him is Albert E. Butler, of the museum's department of preparation, and Clarence S. Rosenkranz, artist.

DR. MICHAEL S. NAVASHIN, of the Timiriasev Federal Institute of Scientific Research, recently arrived at Berkeley, California, where he will spend a year at the University of California. He will work in the genetics laboratories on the cytology of Crepis species and interspecific hybrids. Dr. Jens C Clausen, of the Royal Veterinary and Agricultural College of Copenhagen, has also arrived at Berkeley, where he will work for several months in the laboratories of the division of genetics on Viola and Crepis Dr Clausen has a fellowship under the International Education Board.

DR. PHILIP B HAWK, president of the Food Research Laboratories, Inc., New York City, sailed for

Norway on December 1 to conduct a scientific survey of the methods involved in the production of Norwegian cod-liver oil. He will remain abroad about four months.

E. L. WALKER, professor of tropical medicine at the University of California, has been transferred from San Francisco to Honolulu until April 30, 1928, for his study of the isolation of the leprosy bacillus at the Kahlili Leprosy Investigation Station at Honolulu

LEAVE of absence has been given to Dr. Andrew Watson Sellards, assistant professor of tropical medicine at the Harvard Medical School, for the academic year 1927–28 Dr Sellards will travel to West Africa to make a study of yellow fever and other tropical diseases.

DR A. HRDLIČKA, of the U S National Museum, returned on November 18 from a trip through Europe in the interests of anthropology. The particular object of the journey was to see the most recent discoveries concerning ancient man in Europe. The trip extended through France, Belgium, Germany and Czechoslovakia and ended in England, where Dr. Hrdlička delivered the Huxley lecture before the Royal Anthropological Society on November 8

DR J C HEYMANS, professor of pharmacology, University of Ghent, Belgium, addressed the University of Wisconsin Medical Society on November 14 on "Contributions to the Physiology and Pharmacology of the Vagus and Respiratory Centers"

DR. SVEN INGVAR, docent in neurology, University of Lund, Sweden, lectured on November 16 and 17 at the University of Chicago clinic, under the joint auspices of the Institute of Medicine of Chicago and the department of neurology of the university, on "The Cerebellum Anatomic and Clinical Studies."

DR. NORMAN R STOLL, of the Rockefeller Institute for Medical Research, Princeton laboratories, addressed the class of medical zoology and tropical medicine at the Harvard School of Public Health, on November 23, on the subject "Recent Methods for Determining the Presence and the Intensity of Helminth Infections."

PROFESSOR A. W. C. MENZIES, of Princeton University, will lecture before the Royal Canadian Institute in Toronto on December 10. His subject will be "Atoms and how they combine."

ON November 22 Sir William Bragg delivered the first of a course of four lectures at the Royal Institution on "A Year's Work in X-Ray Crystal Analysis."

THE tercentenary of the publication of Harvey's epoch-making book, "De Motu Cordis," will be celebrated in London under the auspices of the Royal College of Physicians, from May 14 to May 18. Invitations are now being issued, and it is expected that delegates from foreign countries will then gather in London to offer their tribute to the memory of the great physiologist.

A LIFE-SIZED bronze statue of the late Dr. John A. Brashear, maker of telescopes and astronomical instruments and founder of the new Allegheny Observatory, has been placed in the rotunda of the observatory and was unveiled on November 24, the anniversary of his eighty-seventh birthday The statue is the work of the sculptor Mr. Frank Vittor, and is a gift to the University of Pittsburgh from a number of Dr. Brashear's life-long friends

DR. HENRY C. WHITE, professor of chemistry at the University of Georgia, has died, aged seventy-nine years.

DR. D G HOGARTH, keeper of the Ashmolean Museum, Oxford, and president of the Royal Geographical Society, died on November 6, aged sixty-five years.

THE eighth annual meeting of the Southwestern division of the American Association for the Advancement of Science will be held at Flagstaff, Arizona, from April 23 to 26, 1928. A committee on local arrangements has been appointed as follows: Dr Grady Gammage, president of the Northern Arizona State Teachers' College, *chairman*, Dr V. M. Slipher; Dr H S. Colton; E C. Slipher; G. A. Pearson; C. O. Lampland, C. F. Deaver; E M. Mercer, Dr. M. G. Fronske, and Dr. Chas. Ploussard. The following committee will have charge of the program for the meeting Professor William G. McGinnies, University of Arizona, *chairman;* J. J. Thornber; C O Lampland; R. S. Rockwood; D. W. Rockey; Samuel Burkhard, Dr. Byron Cummings; Odd S. Halspeth, and Dr. Elliot C. Prentiss. A special joint meeting will be held with the Pacific division at Pomona College in June. The division has been invited to hold a similar special meeting with the Southwestern division at Flagstaff.

THE twenty-second annual meeting of the Entomological Society of America is to be held at Nashville on December 27 and 28. In addition to the usual papers the society is planning to have a comprehensive exhibit, including photographs, drawings, apparatus, uniques and other material of technical or general interest. The opening session of December 27 will include a symposium on the physiology of insects. In the evening H. T. Fernald, of the Massachusetts Agricultural College, will deliver the annual public address. A second business meeting will be held the

following day, at which officers for the coming year will be elected.

ACCORDING to the *Indicator*, a new organization, composed primarily of the faculty members of the Rockefeller Institute and Columbia University, as well as of members of various other local research laboratories who are interested in physical and organic chemistry, met on November 17. Following a dinner at John Jay Hall, Columbia University, a scientific session was held in Havemeyer Hall Professor T C. Taylor read a paper on "Minor Constituents of the Starch Molecule and their influence on the Properties of Starch" Professor L P Hammett gave a paper on "Some Properties of Electrodes" About ninety people were in attendance and a lively discussion followed The purpose of this organization is to furnish an opportunity for those chemists residing in New York and vicinity, who are interested in the more academic phases of chemical research, to become better acquainted with each other and to report informally upon researches which they are conducting No formal organization has yet been effected, but the general consensus of opinion was that meetings patterned after those of the Society for Experimental Biology and Medicine would be most desirable In the meantime, Dr. D A MacInnes, of the Rockefeller Institute, and Professor V. K. LaMer, of Columbia University, are acting as temporary officers Professor A E Hill has invited the club to the new chemical building at University Heights for the next meeting to be held on December 15.

FREE lectures and demonstrations will be given at the New York Botanical Garden on Saturdays at 3 P. M as follows. December 3, "Air-Plants," Dr H. A Gleason; December 10, "Winter Birds in the Botanical Garden," Mr R. S. Williams, December 17, "Ferns," Dr. Marshall A. Howe, January 14, "Australian and South African Flowers," Mr Kenneth R. Boynton; January 21, "House Plants and their Care," Mr. H. W. Becker, January 28, "Planting Flower Seeds," Mr. George Friedhof.

THE United States Civil Service Commission announces an open competitive examination for junior physicist, applications for which must be on file not later than December 30. The examination is to fill vacancies in the United States Naval Research Laboratory, Bellevue, D. C., in the Bureau of Standards, Department of Commerce, and in positions requiring similar qualifications. The entrance salary in the District of Columbia is $1,860 a year.

AN engineering tour in Europe has been announced by James A. Moyer, president of the National University Extension Association and director of the Massachusetts University Extension, according to *The Christian Science Monitor*. The tour has been arranged by several member institutions of the National University Extension Association and was planned for the benefit of factory and public utility executives, instructors and students in engineering schools and others interested in international industrial conditions Professor N. C. Miller, director of university extension at Rutgers University, and Professor J. O. Keller, director of engineering extension at Pennsylvania State College, with Mr. Moyer are in charge of arrangements. Forty-two days will elapse during the proposed itinerary from the embarkation on the *Tuscania* at New York on July 14, until the return arrival of the *Berengaria* on August 24.

ACCORDING to the *Proceedings* of the Washington Academy of Science the grasses collected on the South Atlantic expedition, 1923–1926, of the Cleveland Museum of Natural History, exploring schooner *Blossom* under the command of George Finlay Simmons, have been sent to the Grass Herbarium of the U. S National Museum for study. Except for a few from Senegal the grasses were collected on islands on both sides of the Atlantic While the collection is not large there are many species not before recorded from Ascension, St Helena, South Trinidad, Fernando Naronha and Cape Verde group A complete set is deposited in the Grass Herbarium.

CALEB C DULA, of the board of directors of the Boyce Thompson Institute for Plant Research, has made a gift to the institute of a photographic laboratory to be equipped as completely as possible for the recording of scientific work. Ultra-violet photography, color work, micro-photography, moving pictures, new devices for photographing roots of plants in water with specially devised reflectors, are among the specialized equipment already planned Besides the recording of the results of experimental greenhouse and field work in all its stages and the making of lantern slides for educational work, much attention will be given to the development of technic with special reference to making scientific records of plant life. Louis P. Flory, formerly of Cornell University, will be in charge of the laboratory.

THE Copper and Brass Research Association has given $2,500, to be added to the metals research fund in the department of physiology at Columbia University

DR. ELLICE MCDONALD, of the University of Pennsylvania, has received a gift of fifty thousand dollars to continue his researches into the causation of cancer. This gift has been taken to the graduate school of medicine of the University of Pennsylvania where it will be administered under a committee consisting of

Dr. Ellice McDonald, *chairman*, Professor William Seifriz, of the department of botany, and Dean George H. Meeker, of the graduate school of medicine. The plan of research is the study of the physico-chemical aspects of cancer and will have associated with it a number of non-medical chemists and physicists. Three scholarships in research will be open in the graduate school for workers familiar with the colloidal aspects of blood such as cataphoresis, particle size determination, tissue cultures, etc.

ANNOUNCEMENT has been made of the gift to the state of Massachusetts of a new wild life sanctuary of 125 acres adjoining the East Sandwich Bird Farm, by the associated committees for Wild Life Conservation, made up of representatives of the Federation at the Bird Clubs of New England, the Massachusetts Audubon Society and the Massachusetts Fish and Game Association. A fresh-water stream, which separates the new sanctuary from the bird farm, will later be dammed up to make a fresh-water pond on the edge of a salt marsh, which has a variety of cover frequented by many species of song and insectivorous birds, as well as game birds. A small portion of the land is now occupied with pens for the breeding of bob-whites. The property borders on Scorton Creek and Mill Stream and will provide the first public fishing ground that has ever been especially established in the state.

AT the British Embassy in London on November 18 the ambassador presented the vice-minister for communications, representing the Japanese government, with a new standard mutual inductance made at the National Physical Laboratory and given to Japan by the British government in place of the one destroyed in the earthquake of 1923 Representative scientists and engineers attended the ceremony. Professor Sakurai, president of the National Research Council, in a cordial speech, paid tribute to the constant assistance Japanese science had received from Great Britain for more than half a century.

UNIVERSITY AND EDUCATIONAL NOTES

THE state legislature has appropriated $3,481,541 for carrying on the work of the University of Wisconsin. There is available $50,000 for research on special investigations, $341,220 for university extension, $30,000 for farmers' institutes, $60,000 for agricultural extension, $30,000 for substations, $5,000 for corn borer work, $63,100 for county agricultural representatives, $5,000 for the state soils laboratory, $2,500 for hog cholera serum, $6,950 for tobacco experiments and $5,000 for experiments with truck crops.

ANTIOCH COLLEGE has received a gift of approximately $300,000 for a new science building from Charles F Kettering, head of the General Motors Corporation research bureau Construction will be started as soon as possible.

FREDERICK W VANDERBILT has given $116,666 67 toward the construction and equipment of the Vanderbilt clinic at the Columbia Presbyterian medical center. Harold S Vanderbilt has given $50,000 toward the construction and equipment of the clinic.

N B. GUERRANT has resigned his position as associate professor of chemical research at the Oklahoma Agricultural and Mechanical College, to fill a position in the department of animal industry, Alabama Polytechnic Institute, where he is devoting his full time to research in nutrition.

DR W H FELDMAN, assistant professor and assistant in veterinary pathology at the University of Colorado, has resigned to accept a position with the Institute of Medical Research of the Mayo Foundation at Rochester, Minn, and has been succeeded by Dr. Henry L Morency.

APPOINTMENTS to the department of biology in Union College for the present academic year include Dr Robert K. Enders, assistant professor of zoology, and Mr. Ralph G. Clausen, instructor in biology

DR. RALPH T K CORNWELL, formerly instructor in organic chemistry at Cornell University, is now at the University of Pittsburgh Dr Cornwell spent last year in Europe, studying at the University in Munich, Germany, and with Professor Fritz Pregl, Graz, Austria.

AT the University of Chicago, Dr. Warren C Johnson has been appointed instructor in general and inorganic chemistry, to succeed Assistant Professor Terry-McCoy, who resigned last March

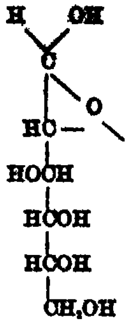
FLOYD S. DAFT, after spending a year of study with Professor S P L. Sørensen at Copenhagen, Denmark, as holder of the Cheney Fellowship of Yale University, has been appointed an assistant in the School of Public Health of Harvard University.

DISCUSSION AND CORRESPONDENCE

ON ACTIVE GLUCOSE

IN an address delivered September 6, 1927, before the division of organic chemistry of the American Chemical Society, the thought was developed that the active forms of glucose, *i.e.*, the fermentable forms, are the free radicles resulting from the opening of the oxygen bridges.

This thought had its origin in the observations of Levene and Walti on the behavior of propylene oxide



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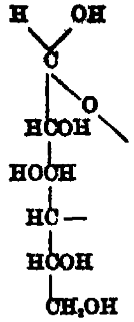

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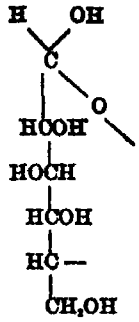
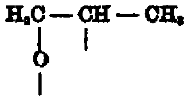


III

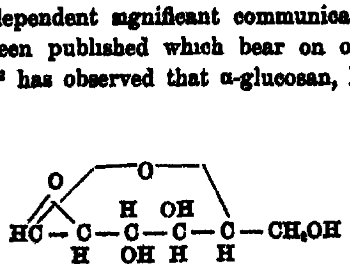
and of glycidol[1] Each of these two substances shows a greater tendency towards condensation as well as towards intramolecular rearrangement than the corresponding alcohol Furthermore, optically active propylene oxide was found to undergo Walden Inversion on hydrolysis with acids This observation was interpreted to mean that in course of the reaction of hydrolysis of the oxide, the free radicle



IV

has for a finite, even though infinitesimal, interval of time an independent existence. From this assumption it would naturally follow that the reactivity of an oxide depends upon the stability of the ring structure and indeed <1, 3> and <1, 4> oxides were found more stable than the ethylene oxide structures. In application to sugars, this assumption would mean that those having the ring structure (I) should be more reactive than those with structure (II) and that those with structure (II) should be more reactive than those with structure (III).

Two independent significant communications have recently been published which bear on our theory Gottschalk[2] has observed that α-glucosan, having the structure



V

and containing an ethylene oxidic ring, ferments at a higher velocity than ordinary glucose and Pictet[3] has found that the same glucosan readily condenses with glucose to form maltose. The reactivity of the α-glucosan is explained by our assumption of the formation of a radicle with free valences on carbon atoms (1) and (2) Thus, these communications furnish additional evidence in favor of our assumption.

P. A. LEVENE

THE ROCKEFELLER INSTITUTE,
NEW YORK

[1] Levene, P A., and Walti, A., *J. Biol. Chem.* 73, 263, 1927; 75, 325, 1927

[2] Gottschalk, A., *Z. physiol. Chem.* 170, 23, 1927.

[3] Pictet, A., and Vogel, H., Helv. Chim Acta 10, 588, 1927.

THE STEPHEN HALES PRIZE FUND OF THE AMERICAN SOCIETY OF PLANT PHYSIOLOGISTS

THE year now ending is the two hundred and fiftieth anniversary of the birth of Stephen Hales and it is just two hundred years since the publication of his best known book, "Vegetable Staticks" Now is therefore a most appropriate time to commemorate the life and works of Hales, and the American Society of Plant Physiologists is planning a Stephen Hales session as an attractive feature of its approaching annual meeting in Nashville. At that session will be officially established the Stephen Hales Prize Fund, an endowment fund that is being accumulated in the form of personal subscription by members of the society. The endowment is to be administered as a perpetual trust by the American Society of Plant Physiologists The income therefrom is to be devoted to prizes in plant physiology, which are to be awarded by the society from time to time Subscriptions already in hand make it certain that an award of fifty dollars can be made every two years, but the amount of each prize may be increased or the award may become an annual occurrence as soon as such changes become possible The prize is to be known as the Stephen Hales Prize in Plant Physiology.

The establishment of this prize will certainly mark a definite forward step, it will surely become a milestone in the progress of the botanical aspect of physiological science. In the first place, it will aid in perpetuating the memory of the great pioneer experimenter whose name the prize bears, whose work looms so large in the historical background of plant physiology. Also, the establishment of this prize may tend to emphasize plant physiology as a science, implying its close relation to the other branches of physiology and perhaps offsetting in some degree a noticeable tendency for present writers to allow this particular branch of fundamental knowledge to become indistinct as such, masked or even lost among its numerous and rapidly increasing applications in plant culture and sometimes overshadowed in its basic relations to descriptive morphology and phylogenetic and genetic botany. And the awards themselves may stimulate research

to some extent, and the presentation of the results of research. Furthermore, in inaugurating the Stephen Hales Prize, the Society of Plant Physiologists will provide a means whereby, from time to time, an excellent contribution in plant physiology may be appropriately signalized as exemplary for its period. As the number of papers thus distinguished grows, the younger investigators in this science may turn to them as models. Finally, each award will constitute a democratic expression of approval and appreciation by the colleagues of the investigator thus honored, and the honor of being selected for the Stephen Hales Prize will surely come to be highly valued. Such considerations as these are in the minds of those who are taking part in this cooperative project.

Persons who desire to take part in the foundation of the Stephen Hales Prize Fund should send contributions at once to Professor Charles A. Shull, Department of Botany, The University of Chicago, making checks payable to American Society of Plant Physiologists, Hales Fund. Contributions of any size will be accepted and greatly appreciated by the society. To make the best showing in the records it is highly desirable that a very large number of American plant physiologists should take part in this foundation.

The name of Stephen Hales occupies a very important place in the history of plant physiology, but his was a mind of very broad interests and he made great contributions in many other fields as well. His earliest botanical studies were made afield, in the region about Cambridge, where he collected specimens and catalogued them with the aid of Ray's *Catalogus plantarum*. He was elected to the Royal Society of London at the age of forty and soon made his first communication to that society, on the effects of the sun's warmth in raising the sap in trees Encouraged by the great appreciation with which this contribution was received, he continued his experimental work along this line and ten years later published his famous book on "Vegetable Staticks."

Hales was curate of Teddington, near London, from 1708 until his death in 1761, at the age of eighty-four. He was interested in nearly all phases of the science of his time He made the first important contributions to our knowledge of blood pressure and won the Copley medal for studies on bladder and kidney stones He turned his inventive genius toward practical problems of human welfare. Among his inventions were ventilating devices for use in mines, hospitals, prisons, ship holds, granaries and the like. In his later years he became interested in the ventilation of heated melon frames and greenhouses.

Among students of plant physiology Stephen Hales will always be known especially for his ten years of experimental study of the intake and movement of water in plants. This was the first scientific investigation of one of the major processes of plant life.

CHARLES A. SHULL,
BURTON E. LIVINGSTON

LOSSES IN TROUT FRY AFTER DISTRIBUTION

I HAVE been asked to reply to some objections which have been urged against Mr White's (seining) method of determining trout fry losses after distribution

1 The traps maintained at each end of the area over which it was expected the fry might spread evidently gave them ample range. For example, the upper boundary on Forbes' brook was an impassable mill dam; the lower boundary was a wire screen and trap which caught only one hundred and two fry, and this trap was located only thirty-three rods below where the main body of fry (4,020) were deposited. *Fry have a tendency to stay near the point of planting.*

2 That débris is caught on the upper boundary screen is perfectly true, and if allowed to accumulate would obstruct the floating food which comes down stream, but débris was always carefully, regularly and frequently removed

3 "Fry play hide and seek with the seiners and are often, after the seining is over, counted as dead when they are in reality only hiding"

There is not the slightest doubt that the percentage of missing fry (71 per cent. to 100 per cent.) quoted in White's reports can always be obtained in the vicinity of many places where fry had been planted by dumping them in large numbers. Now that the folly of this practice has been exposed, and that distribution is taking the place of dumping, there may be an increase of survivals.

4 No injury was inflicted upon the fry or fingerlings while they were confined in the observation compartments—either small or large—on Forbes' brook. They were on shorter rations, of course, but this must be a common experience in fish life, if not an everyday occurrence.

5. Contrast Mr White's experiments with those of Professor Frederic Lee (of Columbia University) on dog fish in 1888–89, at the Woods Hole laboratory. The former did no injury to the trout; the latter cut open the skull and stimulated the inner ear in order to demonstrate the functions. (And he was justified in doing so) In this injured condition the dog fish were kept alive for days at a time. Yet no scientist ever objected to the validity of Lee's conclusions. Indeed, if the objections to White's seining experiments are held to invalidate his investigations then a vast amount of outstanding research in experimental zoology and physiology by some of the best biologists in America will have to be discarded.

6. Granted, of course, that there are many streams which can not be seined (excepting in places) because of numerous boulders, logs, rapids, falls or dense vegetable growth along their banks. There are also streams which can be seined in many places The fish commissioner for Ontario in 1925 dumped trout fry into two hundred and ninety-one ponds and streams Not one stream out of the lot could be seined throughout its length. Parts of every one of them could be seined. It must be the average number of surviving fry in these streams which will determine the utility of fish hatching. In engineering problems, averages must be relied upon, otherwise estimates of cost would be pure guess work There need be no guess work in approximating the losses in trout fry, if only the seining is carefully and repeatedly done

The people of Canada and the United States have in the past sixty years spent millions of dollars upon fish culture They have, therefore, a right to know the approximate average cost of the artificial propagation of fry, fingerlings and adult trout in any given year And they have also a right to know what becomes of them after they are spread in lakes and streams

If seining is not a valid method, perhaps some of the fish culturists will suggest a better one and furnish the public with a description of its working and a statement of the losses which it uncovers. The fish culturists are spending the money It is their duty to show that fish rearing is worth the money which is being spent upon it.

Any sensible man with a government at his back can run hatcheries and distribute fry, especially if there is to be no accounting for dead fry, and if in effect no instruction is given to the superintendent except "Turn out fry and damn the cost"

A. P KNIGHT

KINGSTON, ONTARIO, CANADA

THE USE OF THE TERM ALLOTYPE

THERE seems to be a diversity of opinion as to whether the term allotype should be employed for the first described specimen of the sex opposite to that of the holotype in case it is subsequently described. In the last analysis only the holotype can fix application of a specific name, and it is an academic matter as to whether the other sex be associated at the time of the original description or later. If there has been an error in associating the supposed sexes, the one will be just as incorrectly considered part of the species represented by the holotype if described with it, as though described a century later. Nevertheless, it is important to have the specimen from which the description of the second sex was taken, distinguished in some way, even though the fate of no name may hang thereon, for it is desirable at times to have a source from which the exact meaning of an author can be determined for other than nomenclatorial reasons. Without multiplying terms, allotype should suffice. If the allotype is described with the holotype it is also a paratype and has no more nomenclatorial significance than any other paratype, probably less value than a paratype of the sex of the holotype for there is greater likelihood of its actually representing a different species. If the allotype is described subsequently to the holotype it is not a paratype, and that is sufficient distinction.

R. A. Muttkowski (Milwaukee Publ Mus., Bull. 1, p. 10, 1910) first proposed the term allotype. His original definition of it is quite in accord with my understanding of its proper use and does not sanction its restriction to paratype. It reads "*Allotype*—('αλλος—other) for the sex not designated by the holotype. The allotype need not be described by the protologist (first describer); it can be contained in the original as well as any subsequent description by other authors. Thus if the protolog describes only a holotype male, the first female subsequently described is to be called the allotype."

J. C. BRADLEY

CORNELL UNIVERSITY

CONSIDER THE USER OF BULLETINS

FEDERAL and state experiment station publications of various types constitute one of the principal reservoirs of stored knowledge regarding agricultural arts and sciences. They are the most common form of original record of experiment or research related to agriculture and, as such, become important tools for all professional workers in both agricultural and related biological lines. Lacking ready access to them the teacher and the experimenter find themselves seriously handicapped in their efforts.

Because of their constant and frequent use, most of these workers maintain private files of such station publications as relate to their specific subdivision of agriculture and quickly discover that, because of their great and ever-increasing numbers, some system of cataloguing is necessary to render ready reference possible. Two common bases for cataloguing of this type are in use: (1) the title or subject-matter of the publication, and (2) the name of the author. Arguments favoring either of these bases could be advanced but whichever is chosen the name of the author is nearly always recorded on the catalogue card. It is nearly as important to the user of the publication as is the title itself. It sometimes carries more definite information.

All such bulletins display the title of the discussion on either a cover page or in a table of contents, but many of them fail to show the name of the author in these or similarly conspicuous places Because of this oversight or poor form of publication the cataloguer has to search through several pages of the bulletin or report to discover the name of the author, thus greatly prolonging a disagreeable but necessary task.

The practicability of a form showing the name of the author on the cover page or title page, or in the table of contents if a number of articles were bound together, is assured by its being common usage in many stations Others display the name of the author in a prominent position on technical publications, but conceal it if the treatment is of a more popular nature. Study of recent publications from 20 stations shows 9 which display the name of the author, 2 which always hide it, 7 which vary with the type of the publication, and 2 which are inconsistent in this feature.

Just a simple change in form by some of the station editors would make the use of their publications much more convenient to such workers as catalogue them, and no others can use them to the best advantage.

R. J BARNETT

KANSAS AGRICULTURAL
EXPERIMENTAL STATION

SCIENTIFIC BOOKS

Catalogue of Cainozoic Plants in the Department of Geology, vol I The Bembridge Flora By ELEANOR MARY REID and MARJORIE ELIZABETH JANE CHANDLER (with a section on the Charophyta by James Groves), 206 pp, 12 pls. British Museum (Nat Hist), London, 1926

ALTHOUGH it is some months since copies of this work reached this country, I have seen no reviews of it, and such a scholarly work deserves being brought to the attention of a much larger group of botanists and geologists than are otherwise likely to be aware of its existence.

It is something of a paleobotanical event for the British Museum to start a catalogue of Tertiary floras, particularly since the floras of the earlier half of the Tertiary are abundantly represented in the south of England, and these have never been made available for students, in fact, practically no work has been done on them since J Starkie Gardner stopped in the midst of his labors in 1886. Since that time, as both the authors and Dr Bather point out, geology has advanced, improved methods of study have been devised, and, perhaps most important of all, botanical exploration, especially in southeastern Asia, has made available a wealth of new comparative material

The present volume is devoted to the fossil plants of the Bembridge beds of the Isle of Wight, of Oligocene age This flora is represented by foliar remains, usually fragmentary, and by a large variety of fruits and seeds Hence the authors are especially well qualified for this particular type of study. The senior author—Eleanor M Reid, or Mrs. Clement Reid as the friends of her late husband like to think of her, collaborated with him in his most important contributions to paleobotany, and Marjorie E J Chandler, the junior author, already has several important papers along carpological lines to her credit James Groves, the well-known student of the Charophyta, has contributed descriptions of the 8 species of Chara discovered in these beds

One hundred and twenty-one species are described, of which 42 are new Dicotyledons are represented by over half of the total, and there are 24 monocotyledons, 10 conifers, 1 Equisetum, 8 ferns, and 8 charas. Among the more interesting new things are a splendidly preserved species of *Azolla*—the first convincing fossil remains of this type to be discovered *Hooleya*, a new and extinct genus of the family Juglandaceae and the demonstration that a number, if not the majority, of the fossil fruits referred to the Compositae under such names as *Cypselites, Bidentites*, etc, are not composites, but belong either to the Apocynaceae or Asclepiadaceae. For these the authors propose the new form genus *Apocynospermum*.

Naturally a flora so largely represented by carpological material is difficult to compare with the classic Oligocene floras of Europe based upon leaf impressions or amber inclusions, so that the authors confine their comparisons to selected floras. Among the results of their systematic study the conclusion emerges that, beginning with the upper Eocene and continuing to the end of the Pliocene, the European flora gradually changed from one mainly East Asian and American—largely by the progressive invasion of the region by genera called European, although the species in these so-called European genera still show most pronounced Asiatic and American affinities. They believe that this change in facies was brought about by a southward dispersal from some circumpolar source. They have some slight evidence (*Chlorophora* in the upper Eocene of Hordle) that in the early Eocene direct connections with Africa were not yet broken. They conclude that the climate denoted by the Bembridge flora was probably warm temperate or sub-tropical, and certainly the presence of such

genera as *Acrostichum* and *Palaeothrinax* point toward such a conclusion, as has long been recognized.

It seems to me that Holarctic would have been a better term than East Asian-American, for certainly the evidence is clear that other parts of Asia shared in the growing cosmopolitanism of the Tertiary floras of the Northern Hemisphere. Furthermore, although in hearty agreement with most of the author's conclusions, I can not believe that the Tertiary floristic history was as simple as it has been visualized In Provence, at Haering, and elsewhere in Europe, we see plain evidence of immigrants from Africa, and the dispersal of Tertiary mammals offers some corroborative evidence, as well as of repeated westward spreads from Asiatic instead of northern sources

Here in America the most distinctive elements in the early Tertiary floras appear to me to have been derived from the south, and I believe that the same is true of the warmer climate plants of the English Oligocene I suspect that we will eventually demonstrate many latitudinal swings back and forth, rather than waves of southward dispersal urged by a single progressive cooling in high latitudes

EDWARD W BERRY

THE JOHNS HOPKINS UNIVERSITY

SPECIAL ARTICLES

BLUEBERRY CHROMOSOMES

FOR sixteen years the writer has been making experiments in the hybridization and selection of native American blueberries, species of the genus *Vaccinium*. The practical outcome of these experiments has been the development of valuable horticultural varieties producing berries of very large size Some of the hybrids now in commercial cultivation, Pioneer, Katharine, Cabot and Rancocas, have yielded berries three-quarters of an inch in diameter, and last year the berries of two unnamed hybrids, 1257A and 1443A, reached a diameter slightly in excess of seven-eighths of an inch

In the course of these experiments it was found that certain species, some of them very different in general appearance and in technical characters, hybridize readily Other species, some of them very closely related, are sterile to each other's pollen and yield no hybrids

The lowbush blueberry, *Vaccinium angustifolium*, of the northeastern United States, hybridizes easily with the highbush blueberry of the same region, *V. corymbosum*. The horticultural variety Greenfield is a second-generation hybrid between these two species, containing two quarter-strains of each. The horticultural variety Rancocas is another second-generation hybrid of the same ancestry, containing one quarter-strain of lowbush blueberry and three quarter-strains of highbush blueberry. Natural hybrids between these two species are of frequent occurrence in New England pastures. The plant named in Gray's Manual *Vaccinium corymbosum amoenum* is one of these natural hybrids.

The dryland blueberry (*Vaccinium vacillans*), the Canada blueberry (*V canadense*), and the bigbush blueberry (*V. atrococcum*) could not be crossed with either the lowbush or the highbush blueberry That the highbush and the bigbush blueberry did not hybridize was to me very surprising, for the two species are closely related, so closely indeed that Asa Gray regarded one as a variety of the other

Two southern species, the hairy blueberry, *Vaccinium hirsutum*, and the myrtle blueberry, *V myrsinites*, hybridize freely in the greenhouse with both the highbush and the lowbush blueberry, notwithstanding the great structural differences between the species thus hybridized. One, *Vaccinium hirsutum*, a species of the southern mountains, has a bristly-hairy fruit, inconspicuous winter flowering buds, an extraordinarily large stigma, and almost woolly leaves The other, *V myrsinites*, a species of the southern coastal plain, has very small evergreen leaves, and hardly looks as though it belonged to the same genus as the highbush and the lowbush blueberry of the north. That these strikingly different southern species hybridize easily with the two northern species surprised me greatly.

Desiring to learn the reason for this curious grouping of blueberry species, with reference to hybridization, I tried for several years to induce some one of the plant cytologists to make a study of blueberry chromosomes, but without success. Cytologists are scarce and busy At last, through the mediation of G. N Collins, Dr. A E Longley undertook the sport of hunting the blueberry chromosome He began the work in the spring of 1924 and continued it in the years following, as material became available Dr. Longley's results up to this time are presented in a paper accompanying this paper of mine

Dr Longley has made the discovery, important and significant in blueberry breeding, and fascinating in the facility with which it removes obstacles to this pursuit, that certain species of blueberry have twelve chromosomes, others twenty-four, and still others thirty-six

The highbush and lowbush blueberry, which hybridize freely, both in nature and artificially, have twenty-four chromosomes. In the dryland blueberry, the Canada blueberry, and the bigbush blueberry, no one of which has hybridized with either the highbush or the lowbush blueberry, the number of chromosomes is twelve

The question naturally arose whether the 12-chromosome species would not hybridize with each other. It happened that these crosses had never been attempted, because in these three species no plants had been found whose characteristics were desirable for combination With the new incentive, however, numerous cross-pollinations were made in 1926 between the Canada blueberry and the dryland blueberry and between the dryland blueberry and the highbush blueberry Fruit set promptly, the berries contained an abundance of seeds, and the seeds have now produced vigorous young plants, some of them ready to flower next spring

From still another cross, not yet mentioned, curious results had been obtained This was a cross, made in 1922, between the rabbiteye blueberry of Florida, *Vaccinium virgatum*, and one of the large-berried northern hybrids Many of the pollinations failed, but berries containing seeds were obtained in sufficient number to produce several hundred seedlings They grew with great vigor and flowered freely, but although hundreds of pollinations were made on them with pollen of known virility, not a single well-developed berry resulted, and the occasional small and late berries they bore contained no seed possessing an embryo In the production of offspring this cross, therefore, has proved completely sterile

Upon examining the rabbiteye blueberry, Dr. Longley found that this species has thirty-six chromosomes The plant with which it was crossed has twenty-four chromosomes. The resulting sterile hybrids usually have thirty chromosomes

Since many who read this paper are doubtless unfamiliar with the action of the chromosomes, the minute bodies that are reputed to carry to the offspring the characteristics about to be inherited from the two parents, the following brief statement is presented regarding them It represents the ideas current among geneticists When the first cross-pollination in this series was made, the thirty-six chromosomes from the pollen grain of one parent were poured into the egg cell of the other parent, which already contained twenty-four chromosomes The total of sixty chromosomes was carried through each cell of the resulting hybrid, in the ordinary process of cell division, until the plant was nearly ready to flower Then ensued a phenomenon known as the reduction of the chromosomes, in the cells that produce the pollen grains and the egg cells. Presumably twenty-four of the sixty chromosomes, representing those derived from the 24-chromosome parent, combined with twenty-four of the thirty-six chromosomes representing the other parent The remaining twelve chromosomes from the second parent, having no chromosomes with which to pair normally, paired abnormally with each other or remained unpaired. This abnormal pairing of the chromosomes, according to the current view, caused a derangement of the normal activities of the plant, which resulted in sterility of fruit production.

The rabbiteye blueberry has come into cultivation extensively in the South by the transplanting of the wild bushes It is of great importance that this species be improved by hybridization The first attempt to do this failed, seemingly because the rabbiteye blueberry stood alone in the number of its chromosomes. The possibility of improvement appeared to depend on the finding of another species having thirty-six chromosomes, and possessing also desirable characteristics that could be transmitted to a hybrid

In the higher Appalachian mountains of western North Carolina and eastern Tennessee occurs a native species, *Vaccinium pallidum,* the Blueridge blueberry, which has large, beautiful and delicious fruit As early as 1911, attempts were made to cross this with the highbush blueberry and the lowbush blueberry, but all the pollinations failed, and the Blueridge blueberry was therefore abandoned as a breeding stock

In the hope that this blueberry might be a 36-chromosome species, because it had failed to hybridize with the 24-chromosome species, plans were made, for the spring of 1927, to determine its chromosome number. Material was obtained from western North Carolina through the courtesy of George E Murrell, horticulturist of the Southern railway On critical study of the material Dr. Longley found, to the great delight of all of us, that the Blueridge blueberry has thirty-six chromosomes.

If future experience confirms the view that the number of the chromosomes in blueberry species is a true index of the facility of their interbreeding, as the experiments indicate thus far, we shall be able next spring to hybridize the rabbiteye blueberry with the Blueridge blueberry, and thus add one more item to our knowledge of the means by which wild species become plastic in the hands of science.

Frederick V. Coville
U S Department of Agriculture

CHROMOSOMES IN VACCINIUM

A cytological investigation of the number of chromosomes in a dozen *Vaccinium* species and hybrids has revealed three diploid, six tetraploid, one pentaploid and two hexaploid forms.

The material used for this study of the chromosome in microspore-mother-cells was collected early in the springs of 1924, 1925, 1926 and 1927 from *Vaccinium* plants grown under the direction of Dr. Frederick V. Coville at the greenhouses of the Bureau of Plant

Industry, Washington, D. C., and from plants growing in their wild habitats.

Two methods were used in preparing buds for study. In one, the buds were killed with chromo-acetic killing fluid, embedded in paraffin and stained with Haedenhains haematoxylin. In the other, fresh collected buds or buds killed in acetic-absolute (1–3) were stained with aceto-carmine killing and staining fluid. The former more tedious method was very satisfactory and served as a check against the latter quicker method, which was found to give excellent preparations when the difficulty of using aceto-carmine on the minute anthers of *Vaccinium* was overcome.

Diploid Species

Vaccinium atrococcum, wild plant from Aurora Hills, Va
Vaccinium canadense, wild albino plant (Shear)
Vaccinium canadense, wild plant (La Roche)
Vaccinium vacillans, wild plant from Aurora Hills, Va
Vaccinium vacillans, wild albino plant from New Jersey (MacIlvaine)

These three species were found to have 12 bivalent chromosomes at diakinesis of the pollen-mother-cell Since 12 is the lowest number found in any *Vaccinium* species, it seems probable that 12 is the basic number for the genus, and that the three forms listed are true diploid species. This view is substantiated from our study of *Polycodium stamineum* and *Gaylussacia baccata*, representative forms of two closely related genera The same basic chromosome number, 12, characterizes these two species.

The meiotic phases in the pollen-mother-cells of these three species are passed through in a very regular manner, giving each cell of the tetrad the reduced chromosome number. Text figure 1A shows the chromosomes of *Vaccinium canadense* in the heterotypic prophase The chromosomes are small compact masses at this phase and show no individual morphological characteristics

Tetraploid Species

Vaccinium angustifolium, wild plant from Middlesex Fells, Mass
Vaccinium angustifolium, wild plant (Russell)
Vaccinium corymbosum, wild plant from Lincoln, Mass
Vaccinium corymbosum, wild plant (Taylor No 2)
Vaccinium corymbosum, wild plant from North Carolina (Sampson)
Vaccinium hirsutum, wild plant
Vaccinium corymbosum × *V. corymbosum* (Dunfee × Rubel, plant No 20 of culture 2300)
Vaccinium angustifolium × *V hirsutum* (culture 1560).
Vaccinium angustifolium × *V. myrsinites* (culture 1535).
(*Vaccinium angustifolium* × *V myrsinites*) × *V corymbosum* (culture 1908).

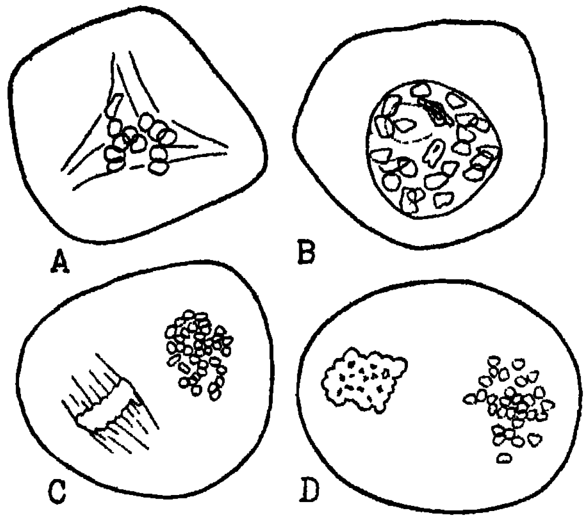


FIG 1 Microspore mother cells of *Vaccinium*. A, heterotypic prophase in *V canadense*, showing spindle and twelve chromosomes, B, diakinesis in *V angustifolium*, showing twenty four bivalent chromosomes, C, homotypic metaphase in *V pallidum*, side view of left spindle, end view of right spindle, the latter showing thirty six chromosomes, D, homotypic metaphase in *V corymbosum* × *V virgatum*, the plate at the right showing thirty chromosomes (A, × 800, B, × 800, C, × 600, D, × 500)

The three species and four hybrids listed above were found to have 24 as the reduced or haploid number of chromosomes

The increase from 12 to 24 chromosomes made it more difficult to find cells where chromosome counts could be made Text figure 1B shows the chromosomes at diakinesis in *V angustifolium* (Russell). The chromosomes show to some extent their paired nature at this stage A few assume such shapes as opened and closed rings but a detailed study of individual chromosome characters was not attempted.

Hexaploid Species

Vaccinium virgatum, wild plant from Crestview, Florida (culture 1881)
Vaccinium pallidum, wild plant from Pisgah Ridge, North Carolina

In the spring of 1926 some buds from two plants of *V virgatum* were procured In this species 36 haploid chromosomes were found.

The discovery of a hexaploid species led us to extend our search. In the spring of 1927 buds of *V. pallidum* were procured Our material gave us only a few well-preserved cells in which the chromosome number could be counted. Fig. 1C pictures the homotypic metaphase of *V. pallidum* showing 36 chromosomes.

Diploid, tetraploid and hexaploid forms all show a regular pairing of chromosomes at diakinesis and abnormalities were very rare in any of the reduction phases.

PENTAPLOID HYBRID

Vaccinium corymbosum x *V virgatum* (Katharine x Rabbiteye)

The reduction stages were studied in several F_1 plants of the foregoing interspecific hybrid. Each showed abnormalities such as are usually met with in hybrids whose parents had different chromosome numbers. Occasionally all chromosomes were paired, giving bivalent chromosomes at diakinesis A regular mother-cell is pictured in Fig 1D, in which there are 30 chromosomes More frequently the mother-cells are found to be much vacuolated and the reduction phases irregular, giving as a result polycary, polyspory and very little normal-appearing pollen

A E LONGLEY
U S DEPARTMENT OF AGRICULTURE

THE STRETCHING OF COPPER WIRE

THE following suggestive experiment has been in use in the Physical Laboratory of Queen's University at Kingston, Ont., for some years As it is thought to embody some novel features it is offered to those who may be interested in it

A light copper wire is *stretched* horizontally on an ordinary laboratory stand, as shown in Fig 1 The depression of its mid-point for various loads is observed through a reading microscope Stress and strain are expressed in terms of the dimensions of the wire, the load and the depression of the mid-point, and, from the plot of one against the other, values are found for Young's modulus, for the stress or strain at the elastic limit, for the yield point and for the stress and the strain *initially* in the wire

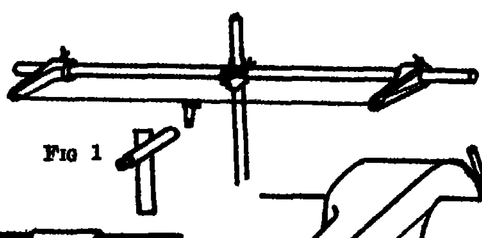


FIG 1

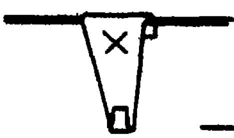


FIG 2

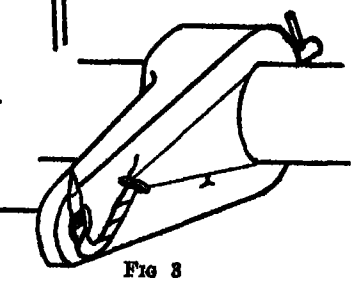


FIG 3

The details are as follows. The most satisfactory grip for the wire ends so far found is made by winding them *tightly* around bent wire nails (See Fig. 3), the wire then passing through the *upper part* of a hole in the bracket arm. A subsidiary wire from the nail head around the horizontal arm holds the nail in place until the wire is stretched by the separation and clamping of the brackets. On the middle of the wire is placed a light hook with a fiducial mark (Fig. 2) The level of the center of this cross is read on

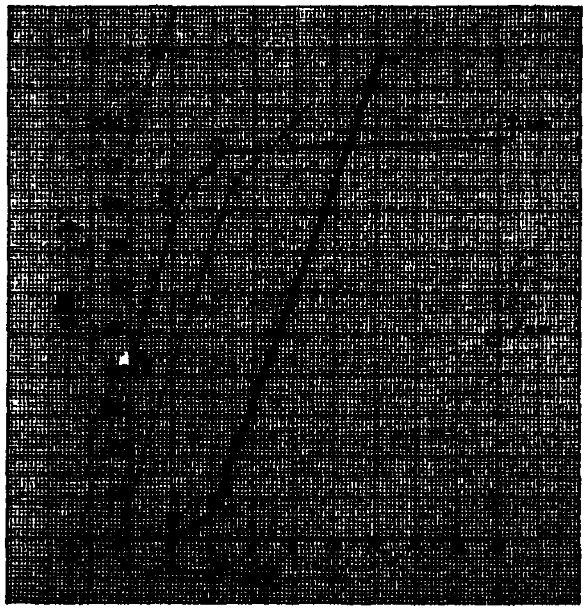


FIG. 4

the microscope scale before any load is applied, after the application of each load and after the load has been removed

For example. Wire from a spool labelled "Bright H. C. Copper Wire No. 26"

Length of wire = l = 91.9 cm (nail to nail)
Radius of wire = r = 0.023 cm

Load M	Level of fiducial mark Under load	Load removed	Depression Under load	Load removed
gm–wt	cm.	cm	cm	cm.
0.0	..	9.140	—	—
50 6	8.250	9 140	0 890	0 000
70 6	8 040	9.140	1.100	0.000
100 6	7 740	9 135	1 400	0.005
120 6	7.600	9 115	1 540	0.025
150 6	7.390	9.095	1.750	0.045
170 6	7 240	9.050	1.900	0.090
	etc.	etc.	etc.	etc.

Using the simplest of vector diagrams and noting that the angles are small we find that the stress in the wire is given by

$$\frac{M}{x}\left(\frac{gl}{4\pi r^2}\right)$$

independently of the initial stress, and that the strain is given by

$$x^2\left(\frac{4}{l^2}\right)+S$$

where S is the strain produced in the wire by the initial stretching and x is the depression

Platting $\frac{M}{x}$ against x^2 we get the graph shown in Fig 4 where the crosses show the values for the table quoted above and the dots show a similar set obtained from another piece of the same wire *but under a much smaller initial strain*

It will be noted that the slope of the line *A B* multiplied by the ratio of the constants $\left(\frac{g\,l}{4\pi r^2}\right)$ and $\left(\frac{4}{l^2}\right)$ gives Young's modulus for the copper used. *B* is the elastic limit and *C* the "yield point" The variation of the level of the fiducial mark from its original position for each of these points is shown by the double line on the plot (scale to the right hand of plot) It will be observed that the break at *E* corresponds with the elastic limit at *B*, and that *F* (where the large yield occurs) corresponds with *C* on the line of stress and strain

And finally, if one extends the line *B A* back to cut the axes, $O\,A \times \left(\frac{g\,l}{4\pi r^2}\right)$ gives the initial stress in the wire and $O\,D \times \left(\frac{4}{l^2}\right)$ gives the initial strain.

WILL C BAKER

PHYSICAL LABORATORY,
QUEEN'S UNIVERSITY

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE REGULAR FALL MEETING OF THE EXECUTIVE COMMITTEE

THE regular fall meeting of the executive committee of the American Association was held at the Urbana-Lincoln Hotel, in Urbana, Illinois, on Monday, October 17, 1927 Three sessions were held, each of about two hours, beginning at 10 00, 3 00 and 8. 00 o'clock, and the members who were present dined together at 6:15 at the same hotel. The following members were present Cattell, Fairchild, Livingston, W A Noyes and Ward. The following items of business were transacted, with the approval of those present and with the subsequent approval of Dr. Humphreys, who added his vote to the five votes of those who were present at the sessions Each item of business consequently has the approval of a majority of the committee and becomes a legal action of the association. The members of the committee who were unable to be present at this meeting are Humphreys, Kellogg, Moulton, A A Noyes, Pupin and Wilson The official minutes of the meeting have now been approved by means of a mail vote

1 The permanent secretary reported that the minutes of the last preceding meeting had been approved by mail

2 The permanent secretary read a communication from the treasurer (dated May 12, 1927), calling attention to the will of the late Benjamin Pickman Mann, of Washington, D C, by which the American Association is to receive the balance of a trust established by the will, after certain provisions have been cared for.

3 The permanent secretary's annual financial report for 1926–27, of September 30, 1927, was accepted and referred to the council

4. The permanent secretary's proposed budget for the fiscal year 1927–28 was unanimously approved This is based on prospective receipts (entrance fees of new members and annual dues) of $70,000, of which $43,000 is to be expended for journal subscriptions for members (SCIENCE or *The Scientific Monthly*)

5 The permanent secretary's annual report on membership for the fiscal year 1926–27 was accepted. On September 30 the total number of members in good standing was 13,930, representing an increase of 537 since the preceding annual report. The total enrolment (including, besides members in good standing, those whose names were retained on the roll although in arrears for one or for two years) was 14,862, representing an increase, since last year's report, of 496, or 3 4 per cent. New members and reinstatements amounted to 1,327 for the fiscal year just closed. The total loss in enrolment amounted to 831, including 178 deaths, 281 resignations and 372 names dropped October 1, 1926, at the close of two years of arrears On October 1, 1927, 412 names were dropped from the roll on account of two years of arrearage The permanent secretary added that 450 new members had been enrolled since September 30, 1927 (This number has now increased, November 14, 1927, to 1,114 and the total enrolment is now 15,572)

6 The permanent secretary reported that $1,310 00 had been received as contributions from members to the Agassiz Bust Fund (see SCIENCE for December 10, 1926) and that that amount had been paid over to the Hall of Fame, New York University The expenses of the committee on the Agassiz Bust Fund were $362 33, met from the current funds of the permanent secretary's office and not charged against the fund. This report was approved and the permanent secretary was asked to make arrangements, if possible,

by which a photograph of the Agassiz bust, when it is unveiled, may be published in *The Scientific Monthly* and copies of the picture may be sent to all contributors to the fund (Work on the bust is now in progress)

7 Dr. Ward presented a report for the special committee on academy relations and in response to this report the executive committee took action as indicated in paragraphs 8–12 below

8 The executive committee recognized the newly formed Colorado-Wyoming Academy of Science, which will hold its first meeting at Laramie, November 25 to 26, 1927, and recommended to the council that this academy be affiliated with the association The region of the academy is Colorado and Wyoming

9 It was voted that the special committee on academy relations consist of the representatives of the affiliated academies in the council (one from each affiliated academy), together with all members of the committee on inter-academy relations that was appointed by the academy conference at Philadelphia and three members representing the executive committee of the association (Ward, Cattell, Livingston) Dr Ward is chairman

10 It was voted that a session of the committee on academy relations be arranged to occur immediately following the first council session at Nashville, on the afternoon of Monday, December 26

11 The permanent secretary was asked to arrange a complimentary dinner of the committee on academy relations, to be paid for out of the current funds of his office, for the evening of Monday, December 26, following the committee session and preceding the opening session of the Nashville meeting The permanent secretary was asked to invite Dr Wilhelm Segerblom, recently president of the New Hampshire Academy of Science, to be a guest of the committee for the session and for the dinner, requesting that he take part in the discussions Dr Segerblom has made a study of the state academies of sciences and gave some of his results in his retiring presidential address before the New Hampshire Academy at Waterville, N H, on June 4, 1927 His address is soon to appear in SCIENCE

12 The official affiliation of the Society for Experimental Biology and Medicine was ratified The society has 784 members, of whom 390 are fellows of the association. It is to have two representatives in the association council

13 The official affiliation of the South Carolina Academy of Science was ratified. The academy has 54 members, of whom 18 are now members of the association

14 One hundred and seventy-two fellows were elected, distributed among the sections as follows:

Section B (Physics)	1
Section C (Chemistry)	65
Section F (Zoological Sciences)	15
Section I (Psychology)	79
Section L (Historical and Philological Sciences)	1
Section M (Engineering)	3
Section N (Medical Sciences)	7
Section O (Agriculture)	1

15 The rules for the award of the American Association prize of $1,000 were reviewed and it was voted that the Nashville award is to be made according to the rules followed at the fifth Philadelphia meeting These rules were published in SCIENCE for December 2

16. The executive committee made an appropriation of $100, from the treasurer's funds, to aid the work of the National Conference on Outdoor Recreation

17 A request was considered, from the mayor of Southwark, for a financial contribution to the Faraday Memorial Collection, kept in the Central Reference Library, Southwark, London, and the permanent secretary was asked to inform the mayor that the association has no funds that might be employed in this way but that it highly approves of the Faraday Memorial Collection Through its official journal, SCIENCE, the association will be glad to give publicity among American scientists to a letter or note on this subject that may be sent to the permanent secretary.

18 Evening and afternoon lectures of a non-technical nature were approved for the Nashville meeting, as these may be arranged by the permanent secretary.

19 The executive committee approved the plan of having at the Nashville meeting a lecture by a British scientist if that can be arranged

20 The following resolution was adopted

Resolved, That the American Association, as one of the sponsor organizations for this project, approves the list of standardized mathematical and engineering symbols referred to in SCIENCE for August 12 and September 9, 1927 The list has been published in full in the *Journal of Engineering Education* for June, 1927; the *Journal of the Society of Automotive Engineers* for July, 1927, and *Mechanical Engineering* for August, 1927

21 Dr Fairchild presented an invitation from the president of the University of Rochester, requesting that the annual meeting of December, 1933, be held at Rochester, N. Y This invitation was tentatively accepted, pending detailed arrangements.

22. The executive committee adjourned to meet at the Andrew Jackson Hotel in Nashville at 10:00 o'clock on Monday, December 26, 1927.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENCE

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THE STATE ACADEMIES OF SCIENCE AFFILIATED WITH THE AMERICAN ASSOCIATION[1]

SINCE the New Hampshire Academy of Science is now affiliated with the American Association for the Advancement of Science and is advancing shoulder to shoulder with twenty other affiliated state academies, it seems worth while to learn what these other organizations have accomplished and in what activities they are at present engaged This address presents some of the results of a study of those questions

Brief statements concerning the organization and work of sixteen of the affiliated academies were published in the last volume of "Summarized Proceedings of the American Association" (1921–1925), which appeared in December, 1925 Since that time five additional academies have become affiliated with the association [2] In preparation for the study here reported, a questionnaire of eighteen specific questions was sent to the secretaries of all the academies in this group, excepting our own, and all but two of the twenty secretaries responded, some of them sending additional information about their academies. That the secretaries were keenly interested in the study is shown by the receipt of many publications from fourteen academies Several of the secretaries expressed a desire to receive the results of the detailed study of the material collected.

Academies affiliated with the American Association exist in the following states Alabama, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Nebraska, New Hampshire, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania,[2] Tennessee, Virginia, West Virginia, and Wisconsin Reference to the map shows that these states form a group extending from the Atlantic Ocean to the Mississippi River, with an arm extending from Iowa through Nebraska and Kansas to Oklahoma The region south and west of the last named states has no affiliated academies at present, partly because it is covered by the Pacific Division and the Southwestern Division of the American Asso-

[1] From the address of the retiring president of the New Hampshire Academy of Science, delivered at Waterville, N. H., June 4, 1927.

[2] A sixth additional academy (of South Carolina) became affiliated October 17, 1927 There are twenty-two in all.

ciation.[3] Some of the states in the regions of these two divisions have unaffiliated academies, as is also true with several other states outside of the regions of the divisions.

Of the twenty-one academies to be studied, sixteen have as their titles the name of the state followed by the words Academy of Science These apparently take *science* to cover most of the field of classified knowledge and orderly thinking Three use the phrase Academy of Sciences, thinking apparently of the cooperation and coordination of the separate fields into which science is too often or too definitely split up, these three academies are those of Maryland, Nebraska, and Louisiana, the last-named of which takes the name of the New Orleans Academy of Sciences. The two remaining academies add two other fields of intellectual effort They are the Michigan Academy of Science, Arts and Letters, and the Wisconsin Academy of Sciences, Arts and Letters

The New Orleans Academy is the oldest of the twenty-one present organizations, having been formed in 1853, and the Alabama Academy is the youngest, formed in 1924. There seem to have been three active periods of academy formation, three academies were formed in 1866–1870, five in 1885–1894, and eleven in 1902–1924 There seem to have been obvious though slightly less well defined active periods of academy formation in the years following the civil war and directly after the world war. Historians may see some significance in this last observation. The Iowa Academy of Science was organized in 1887, though it succeeded the Iowa Academy of Sciences which lived from 1875–1880 The Maryland Academy of Sciences was reorganized in 1866, as the successor of the Maryland Academy of Science and Literature, which was itself a reorganization in 1819 of the Academic Society, formed in 1797. To the Maryland Academy belongs the credit of being the pioneer in this field

In this connection it should be mentioned that the formation of the New Hampshire Academy of Science in 1919 occurred at the suggestion of Dr J. McKeen Cattell, editor of SCIENCE, the initial steps in the actual organization having been taken by a committee consisting of Professor John H. Gerould, Professor Norman E. Gilbert, and Dr John M. Gile, of Hanover, with the cooperation of Professor W. C. O'Kane, Dr. Charles James, and Mr. H. L. Howes, of Durham This was the outcome of a plan of the American Association to cooperate with the state academies of science and to encourage their foundation in states where they did not already exist. Dr. Cattell was one of the leaders in bringing about the arrangements for the official affiliation of state academies with the American Association, arrangements that began to operate in 1918[4]

The number of members enrolled varies from fifty for New Orleans to about eight hundred for Maryland and for Indiana. The small size of the first-named academy is doubtless due to its being largely local and limited to research workers. The number of members apparently bears no relation to the age of an academy, it may depend on the population of the state, on entrance requirements or some other factor. It should be noticed, however, that the three academies having the largest enrolment include non-resident members

The classification of members seems to be governed by no general principle, in fact, there is much confusion here There are three academies (Alabama, Georgia, and New Orleans) with only one kind of members (active members), and there is one (Maryland) with six kinds (corresponding, associate and corporate members, fellows, patrons and founders). Examination of the complete list reveals these additional kinds. local, national, life, non-resident, annual, honorary and regular members, honorary fellows and life fellows New Hampshire stands alone in having only two kinds, active and honorary members, with Michigan a close second, adding life members to the two kinds we have Four academies have national members, meaning persons who are also members of the American Association for the Advancement of Science. All the academies have members with the standing of our own active members, though they are sometimes designated by different names. Thirteen have less than five kinds of members Two have six kinds. Confusion is greatest in those cases where a member may belong to two different classifications; *e.g.*, the Oklahoma Academy has active members and fellows, and each of these may be either local or national; it also has honorary members Seven of the academies list non-resident members, usually former active members who have moved from the state. Twelve academies have honorary members, or members of similar standing. The limitations to this honor are interesting. For New Hampshire the number is limited to ten, with a total enrolment of

[3] The Pacific Division now includes all members of the association residing in Alaska, British Columbia, Washington, Oregon, California, Idaho, Nevada, Utah, Mexico (excepting Sonora and Chihuahua), the Hawaiian and the Philippine Islands and other islands of the Pacific. The Southwestern Division now includes all members residing in Arizona, New Mexico, Colorado, Sonora, Chihuahua and Texas west of the Pecos River.

[4] For a list of the first academies to be affiliated and the dates of their affiliation, see SCIENCE for June 17, 1921.

131; for Kentucky the number is twenty, with an enrolment of 170, and for Ohio it is only twenty-five, with a total of 475 The other academies have, according to their constitutions, placed no limits on the number of honorary members. It is surprising that two (Kentucky and Ohio) confer this honor only on non-resident members, formerly the Nebraska Academy had a similar rule but rescinded the non-resident condition in 1920 Two academies (Michigan and Wisconsin) confer honorary membership for distinguished or conspicuous service in science, arts or letters, while one (Tennessee) confers this honor on "any white person who has attained prominence in any department of science"

The classification of members has apparently been established to meet local needs in each case The multiplicity of names seems unfortunate, particularly as different names are sometimes used by different academies to designate the same kind of members Simplification of nomenclature seems desirable and should make easier that correspondence between affiliated academies which is appearing so promisingly on the horizon, in connection with official affiliation with the American Association. It is suggested that the affiliated academies might, in cooperation with the American Association, bring classification of membership and the nomenclature thereof into closer agreement.

The payment of $20 in one academy (Illinois), $25 in two (Michigan and Nebraska) and $50 in one (Virginia) entitles a person to life membership The payment of $100 in four academies (Indiana, Nebraska, North Carolina and Ohio) entitles a person to the standing of patron; the Virginia Academy, however, requires $1,000 for this form of membership

Qualifications for membership may be covered generally by the statement that in fourteen of the academies any one "interested in science," "interested in the progress of science," or "interested in scientific work," to quote from the constitutions, may become an active member The New Hampshire Academy is the only one that attaches an age limit (twenty-five years). Unless the committees on membership scrutinize applications very carefully, it seems to be rather easy to get into most of the academies. A few have more definite requirements; *e g.,* Georgia requires five years of recognized scientific work or five years of productive work in a college faculty, or some noteworthy contribution to science; Illinois demands interest in science in the state and in the nation; for Indiana the candidate must be engaged in original research or some other phase of scientific work; New Hampshire wants proficiency in some branch of recognized science; North Carolina wants active interest in the promotion of science, while for Oklahoma, Pennsylvania and Tennessee the candidate should preferably be engaged in scientific work. Maryland again stands out in requiring, in addition to an interest in science, a desire for self-improvement and a desire to help others, this may be related to the fact that the Maryland Academy is "principally a popular academy in which any intelligent person of good character may participate" Curiously, two academies (New Orleans and Wisconsin) report that no qualifications are required for active membership On the whole, qualifications seem to be framed broadly enough so that acquaintance with scientific workers in other fields than one's own may be obtained in a social and appreciative way without too much detailed machinery of enrolling The experience of some academies in regard to membership qualification may well be useful to other academies and it might be very valuable if these qualifications might receive special attention from the Committee on Academy Relations, recently established by the American Association (SCIENCE for May 20, 1927, page 508, paragraph 14)

Annual dues are very moderate in all these academies, one dollar in eight academies and two dollars in four Four academies require an initiation fee of one dollar, four require a two-dollar fee, and one a three-dollar fee Annual dues of one or two dollars seem much more desirable than higher dues. Academy publications might better be financed in other ways than by means of annual dues, as will appear later in this paper

In order to evaluate the objects or purposes of the state academies, each secretary was asked if the main object of his academy was "(1) to promote scientific research among purely scientific investigators of your state, or (2) to increase the fellowship among persons having scientific interests though not necessarily engaged in research" Dr A. M. Peter, secretary of the Kentucky Academy, sent this reply. "The constitution of the Kentucky Academy declares that the object of the academy is 'to encourage scientific research, to promote the diffusion of useful scientific knowledge, and to unify the scientific interests of the State' I think, however, that most good comes from bringing together those who are interested in scientific matters in the state, whether they are actually doing research work or not—that is, I think the most important duty of the academy is that described in your second item." This expresses very happily exactly what I think we all feel our own New Hampshire Academy stands for. It also expresses substantially what the majority of the secretaries express in varying ways. Two academies (Kansas and New Orleans) rate fostering research as more important than increasing fellowship; two others (Pennsylvania

and Tennessee) rate the two objects in the reverse order, and one (Iowa) rates the two about equally Other comments of the secretaries are The Indiana Academy maintains a research committee to receive requests for solutions of definite problems for the people of the state, and to assign them to proper experts for solution The Maryland Academy seeks to be a popular center for all interested in natural science The Michigan and Wisconsin Academies include also arts and letters The New Orleans Academy emphasizes pure research almost exclusively The North Carolina Academy finds that most of the actual work of the academy is done by the investigators The secretary of the Virginia Academy, Dr E C L Miller, says "Ours is a young society and the work so far has been mostly to build up the society and to promote fellowship among the scientists and good will toward science in the state. Now we have a permanent committee on research and are raising an endowment fund for this committee"

An examination of the academy constitutions gives additional support to the statement that Dr Peter's reply, quoted above, is of general application Indiana adds this object "to assist by investigation and discussion in developing and making known the material, educational and other resources and riches of the state, to arrange and prepare for publication such reports of investigations and discussions as may further the aims and objects of the academy" Tennessee includes exactly these words and Oklahoma includes an abridged form of the same statement North Carolina hopes "to furnish, so far as practicable, a means of publication of such articles as may be claimed worthy" Wisconsin says "Among the special objects shall be the publication of the results of investigation and the formation of a library" Maryland supports a museum and maintains meeting rooms Virginia lists as her fourth and fifth purposes, "to cooperate with other scientific bodies having similar aims and to render public service in scientific matters"

If the worth-whileness of any state academy of science is ever questioned, this enumeration of objects and purposes should certainly justify the existence of the organization It should encourage us in renewed loyalty to and support of our own New Hampshire Academy and should make us proud that we are affiliated with such forward-looking scientific organizations. One secretary writes· "If your research discloses a very good reason for the existence of state academies of science I want to know it in order that we may get into the right line." He considers that the reading of scientific papers does not seem to him very important, but may be only a good excuse for getting the members together and giving them a chance to find out that the others are interested in what each one is doing. He then adds this significant suggestion "I think the academy should have some hobby but I do not know what it ought to be"

As to the number of meetings per year, the academies are in close accord Fifteen have but one meeting a year while three have two meetings. Two academies (Georgia and Oklahoma) specify that there may be extra meetings at the call of the council Eighteen academies meet for the reading of papers and most of these mention transaction of business as one of the features In the case of those that do not specifically mention business it is not clear just how it is transacted Business may be delegated to a council or similar body In several cases, including our own New Hampshire Academy, the council is instructed to transact business that arises between the annual meetings

It is of interest that three secretaries specifically mention discussion as a regular part of the program, perhaps it should be inferred that other academies include this helpful and attractive feature without mentioning it. It may be that some academies are losing out to some extent by not stressing this feature Four include regularly a lecture by a person of note, usually from another state Opportunity for social intercourse is mentioned several times, luncheons, banquets, social gatherings, etc, occur in the programs. It appears that in most of the academies much is made of the encouragement of better acquaintance among the members. On the whole then the character of the meetings is pretty uniform.

Marked variations are in one academy (Virginia) the program is stated to be made up of "papers mostly," and in two others (New Orleans and Wisconsin) of "papers only" Nebraska lists "Demonstrations" as part of the program Experimental demonstrations or exhibitions of material might enliven considerably papers that would otherwise be less interesting and they might well be used much more than seems to be the case. Experience at various chemistry meetings has shown the markedly increased "selling value" of a paper that is thus accompanied by exhibit or experiment An Ohio program lists nine exhibits relating to botany and zoology, and speaks of their not being as numerous as in the preceding year

Eleven academies make field meetings part of the regular program. Two (Indiana and Oklahoma) devote the spring meeting entirely to inspecting industrial plants, visiting regions of geological or biological interest, etc., the reading of papers being reserved for the winter meeting. Most of the others combine field trips, as do we, with the regular pro-

gram of papers at the annual meeting. The Illinois Academy specifies that its field trips are designed "to stimulate interest in local flora, fauna, geology and industries"

It now becomes my sad duty to report that eight of the academies go on record as having no field trips, and examination of the literature received does not indicate that they employ such trips even "only incidentally," as one of the eleven mentioned above puts it To those of us who have so keenly enjoyed our own field trips it must seem that those eight academies are omitting one of the most effective agencies to increase mutual acquaintance and to learn to see things through the other fellow's eyes

In my enthusiasm for the field trips I almost forgot to say that the Maryland Academy of Sciences meets "every night," according to the blank returned from Baltimore Probably this means every night but Sunday The subjects taken up are varied The members are "taken to the field under competent instructors for the purpose of investigation or study" It should be recalled that the Maryland Academy is organized definitely as an institution for public education in science, being thus different from any of the other academies studied

The membership of the Georgia Academy is divided into eleven groups according to the subject in which each member is most interested Similarly, Nebraska has eight groups Programs are correspondingly divided In an organization the size of ours here in New Hampshire such subdivision of the program would be entirely out of place and would defeat the main purpose of our coming together In larger organizations, with large numbers in attendance, such subdivision may be advisable or even necessary.

As to the papers and addresses themselves, our own New Hampshire Academy may serve as an example In the past seven years 106 papers have been presented, of which 15 were presidential addresses or formal lectures This makes an average of 15 papers per meeting The smallest number was eight, in our first year, and the largest was twenty-one, in 1923 When we remember that between supper Friday night and bed-time Saturday night there are available two evening sessions and two half-day sessions, we see how the number of papers may vary from year to year One year there was no presidential address or formal lecture and the next year there were four papers of that kind. When Saturday afternoon was devoted to an inspection trip through an industrial plant or a college the number of papers was naturally smaller.

A hasty skimming of such programs, abstracts of papers and reports of meetings as are at hand indicates that the papers presented before other state academies do not differ markedly in number or character from those given at the New Hampshire meetings. In a few cases the papers have more direct bearing on the problems and progress of the state in which the academy is located. In some cases the papers seem generally to be the result of considerable scientific investigation, the kind of papers published in the special scientific journals Such more technical papers may be more appropriate for some of the larger academies than for the smaller ones For us, however, this might be taken as suggesting a possible bettering of our own programs, or at least as a hint that we should not neglect our service to our state in the midst of our personal scientific enjoyment

Of great interest to those making up academy programs and those presiding at the meetings is that several of the programs examined show a time limit after the title of each paper This device has proved so satisfactory in other organizations that it might perhaps be more generally adopted by the state academies The most extreme case noted was a program that limited all papers to ten minutes each

It may be of interest to list here a few titles of presidential addresses selected from the academy reports at hand Some presidents deal with the special subjects in which they are directly interested, while others deal with broader and more general aspects of science Of course the president should try to feel the pulse of his academy and to point the way to a larger vision The titles selected are as follows

Bacteriology and its practical significance (C A. Belvrem, Indiana)

Flora of Indiana On the distribution of the ferns, fern allies and flowering plants (C C Dean, Indiana)

The unselfish service of science (W M Blandard, Indiana)

Biological laws and social progress (H L Bruner, Indiana)

The earth's framework (E R Cumings, Indiana)

The social responsibility of science (O H Smith, Iowa)

Geology of some proposed Kentucky State parks (W. R Jillson, Kentucky)

The effect of the teaching of evolution upon the religious convictions of undergraduate students, as evidenced by theses upon this subject (A. R. Middleton, Kentucky).

Science and letters (C Bamer, Michigan)

American botany during the colonial period (H. H. Bartlett, Michigan).

Recent research in atomic structure (J C Jensen, Nebraska)

Accumulation of energy by plants (E N. Transeau, Ohio).

Research in industry (J. H Cloud, Oklahoma)

Research as a state policy (H L. Dodge, Oklahoma).

Conservation from a biological standpoint (C. E. Sanborn, Oklahoma)
Research in secondary schools (A. F. Reiter, Oklahoma)
The possibility of the redemption of the great plains from their semi arid condition (J. B. Thoburn, Oklahoma)
Church and science (I. F. Lewis, Virginia)
Some reactions of man to platinum (J. L. Howe, Virginia)
What is science? (L. B. Richardson, New Hampshire)
A skeptical inquiry into the creed of science (W. B. Van Arsdel, New Hampshire)
The open mind (W. C. O'Kane, New Hampshire)
Backgrounds (F. H. Foster, New Hampshire).

The academy secretaries were asked in what way their academies cooperate with state departments and state organizations, with a view to making known the resources and advantages of their respective states. Ten academies make a definite effort to cooperate in this way, five cooperate only a very little, while four answer the question in the negative. The following are mentioned as avenues for cooperation: close contact with the State Educational Association, making the meetings as educational as possible, publication of papers on surveys, working with the State Conservation Commission, fostering research, having representatives of the state departments read papers and take part in the discussions, maintaining a conservation committee, acting in an advisory capacity to state departments on scientific matters, placing papers at the service of the public, supplying scientific information to the state legislature, keeping tab on legislation affecting scientific interests, having papers on the resources of the state, and offering the services of the academy to the governor in the capacity of an advisory scientific body to the state. Cooperation seems to be a reversible reaction. In Iowa a plan is on foot for the state to appropriate $2,000 or $3,000 for a biological and natural history survey of the state, the academy to furnish the experts. In Illinois the state surveys contribute papers to the Academy Transactions and the Transactions are published by the state.

Closely associated with the topic just considered are the replies to the question, "in what other way does your academy contribute to the scientific progress of your state?" Two secretaries say their academies contribute nothing, one is doubtful, another recognizes ungrasped opportunities by saying, "I am afraid we have done very little," while fifteen mention specific ways in which they justify their existence. The secretary of the North Carolina Academy, Dr. H. R. Totten, mentions the largest number of ways: That academy publishes important papers read at meetings and abstracts of the others, works for better scientific teaching in high schools, supplies speakers for educational meetings and for high schools, offers a state prize for the best essay by a high-school pupil on a scientific subject, keeps in close touch with the State Department of Education, arouses interest in the American Association for the Advancement of Science, and works for freedom of thought, of research and of teaching.

Several other secretaries send lists nearly as long. The following may be mentioned in addition: arousing public interest in scientific matters, backing legislative bills of a scientific nature, publishing papers primarily for non-scientific readers, conducting symposia for teachers in high schools, making the American Association for the Advancement of Science annual allowance available for grants for scientific work, encouraging graduate students to do research work, endorsing public movements like those for national parks, conducting a bureau of information at the service of the people, presenting non-technical lectures, publishing results of research connected with state affairs, encouraging beginners in science, fostering higher standards of scientific work in the state, and offering prizes or financial aid to meritorious projects. Though some of these items are plainly adapted to restricted and local use, still they supply suggestions for future activity to any academy that is looking for some new way to serve its state.

The question, "Do you have interchange of speakers, of ideas, or of reports on scientific work with other academies and if so to what extent," brought out the fact that ten academies practice no such interchange, while five have only occasional interchange. The secretary of one of the latter said, "Only occasionally and then rather accidentally." Four secretaries mention having out-of-state speakers, not always, however, drawn from the academy of a neighboring state. Three academies have had a joint meeting with a neighboring academy. One (Illinois) has an "out-of-state speaker for the complimentary address to the public." Another (Maryland) invites all visiting scientists to attend its lectures. One (Tennessee) "very rarely" has interchange, but the secretary adds, "I hope to see organized during the meeting of the American Association for the Advancement of Science in December, 1927, a Federation or Union of State Academies which will promote these things." Three academies (Illinois, Ohio and Oklahoma) exchange their publications with the other state academies, Oklahoma exchanging "widely, both in America and abroad." It thus appears that closer relationship among the state academies would be very helpful in general and it is clear that this feature of academy work is apt to receive more attention in the future.

Only four academies have museums. The Maryland Academy has done most along these lines. Having started with the Peale Museum, in 1797, it now maintains a constantly developing museum of science and natural history, housed in its own building and freely open to the public from 9 A M to 4 P M., after which hours it is open only to members The Kansas Academy has merged its museum with that of the State University The Indiana Academy is cooperating with the State Museum and with the local historical societies in extensive mound exploration and is depositing all its material in the State Museum The North Carolina Academy maintains no separate museum, but members of the State Museum are active in the academy and there is close cooperation

Nine academies have no libraries Two have no separate libraries, Iowa deposits its books in the state library, while Michigan has merged its library with the State University Library Eight academies have libraries Tennessee "only a few volumes, just beginning", Illinois about the same, Ohio about 300 volumes, Kansas 4,000, Indiana 6,000, and Wisconsin several thousand volumes and 700 exchanges The Indiana Academy library is in the same building with the State Library, the Wisconsin Academy library is incorporated with that of the State University The Oklahoma Academy library is handled as part of the State University Library, but books are cataloged and shelved separately and book-plated "Academy" Provision is made for the removal of all academy books at any time. Most of these academy libraries aim to be extensive collections of scientific literature in general, rather than smaller collections of such reports of scientific investigation as the members might not find in their university libraries. The Maryland Academy library, however, contains many rare scientific volumes.

The Maryland Academy is the only one on our list that owns its own building. The fact that nine academies are incorporated shows that they are looking forward to future material resources and broader activities.

All academies but two (Georgia and New Orleans) issue some kind of a publication. *Proceedings*, *Transactions*, *Journal* and *Annual Reports* are titles most frequently used. *Abstracts* as a title is used once, as also is *News-Letter*. These printed reports vary in size from a 20-page pamphlet to a 450-page volume; they average perhaps 150 pages per year In eight cases the publication is financed from the dues or general fund of the academy. In five cases the state finances the undertaking, in two out of these five cases (Indiana and Wisconsin) the state appropriates $1,500 annually. In two states (Michigan and Oklahoma) the state university pays for part or all of the academy report. The academies of Nebraska and Oklahoma are planning endowments to take care of all the publication expenses. For the North Carolina Academy the Proceedings are published by the Journal of the Elisha Mitchell Scientific Society, of the University of North Carolina, the university and the academy dividing the expense between them The extent to which state academies have gone into the publication of reports is shown by the fact that the Indiana, Iowa and Kansas academies have each published over thirty volumes. Several of the publications are well illustrated Alabama publishes simply abstracts of its papers in pamphlet form. New Hampshire has not yet entered the printed-page field, but it has furnished to its members mimeographed *News-letters*, somewhat irregularly, but on the average of about one a month. These contain the programs and announcements of the meetings, abstracts of papers read, and—what does not appear in any of the literature received from the other academies—news items about the members. In this last respect we appear to be a step ahead of the procession

In another way the New Hampshire Academy appears to stand alone, no other academy has published any handbooks of its state, such as the Handbook of the Geology of New Hampshire, prepared by Professor J W Goldthwait for the academy and financed from the academy funds

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If we take as a starting point the foregoing outline of what the twenty-one affiliated academies have accomplished in the various states and how those accomplishments have been brought about, we may now look into the future through the lenses of what appear to be present opportunities, to secure some suggestions for the further development of the academy idea. It seems perfectly clear that state academies of science have been and are very valuable indeed, not only to their members but also to the progress of science and education in general in their respective states and consequently to the public at large Such a conclusion is strongly supported in a very notable way by the enthusiastic and cordial response with which the academy secretaries to whom our questionnaire was sent have responded to our questions As has been said, many of these secretaries, all of whom are very busy men, answered our queries with much more than perfunctory care, their replies indicate a very high degree of painstaking interest and enthusiasm for the work of their academies and for the cooperation of these organizations through their official affiliation with the American Association. To these secretaries is primarily due

any value that lies in the present paper and to them I wish to express my cordial thanks.

Besides reflecting their own faith in the work of their academies and the similar and obvious faith of their fellow members, these replies from the secretaries of the affiliated academies also strongly reflect what appears to be a very wide-spread and general feeling that the work of the academies should be strengthened and broadened more and more through alertness to take advantage of all opportunities that may arise in each case As a concluding part of this paper I may mention some of the kinds of opportunities that seem to lie before these organizations, as such opportunities have been suggested by this study of the affiliated academies. These suggestions may be classified in two groups, opportunities for strengthening and enlarging the work of each academy in its own state and opportunities for broader and more active cooperation among the several academies, for mutual help and for the advancement of science and education throughout the country as a whole It will be convenient and perhaps most serviceable to present these two categories of suggestions from the standpoint of our own New Hampshire Academy, with which I am naturally best acquainted

From the standpoint of our own work in our own state, the following suggestions are tentatively put forward

1 We might continue to increase our membership, to enroll with us all persons in New Hampshire who legitimately belong with us through their work and interests This implies an active and continuous campaign to attract new members

2 We might make our news-letters so interesting that those publications might aid greatly in holding, as non-resident members, all members who move into other states

3 We might put into operation the plan that Secretary Hartshorn and myself outlined last June (for reasons that seemed to us good and sufficient it could not be put into complete operation this year) *viz*, to bring out the *News-letter* regularly—as on the fifteenth of each month—and to give it such interest that members would look forward to its coming each month.

4. We might show our appreciation of the really remarkable little "Handbook of Geology," which Professor Goldthwait has generously written for our academy, by increasing its circulation as rapidly as possible and preparing for a second printing

5 We might logically select from the fauna, flora, forestry, mineralogy or ornithology of New Hampshire suitable subjects for one or more additional handbooks, starting the preparation before the call for such service to our state, which is becoming manifest, has become so loud that we may seem to be neglecting our opportunities

6 We might try to attract to our academic fraternity the workers in our state departments, adopting some of the relationships which have been found advantageous in other states and thereby bringing about increased and enlivened cooperation between state departments and the academy

7 We might develop especially the interest we have already shown in the educational problems of our state, as by offering our services in connection with the numerous educational activities This might be accomplished through cooperation with the State Department of Education or independently The academy might undertake to furnish speakers on scientific subjects wherever such speakers are desired

8 We might contribute more than we now do to the scientific progress of our state by organizing surveys of local conditions, and by spreading the gospel of improving unfavorable conditions through the greater use of scientific (meaning sensible) methods of procedure

9 We might begin to look forward to and plan for an academy museum and an academy library, well housed and located as centrally as possible in the state, in charge of a permanent curator and librarian who might act as a bureau of information on academic matters of interest to our members Such an academy museum might house (1) specimens of animal life (native, wild, migratory, and perhaps domestic) found in New Hampshire, (2) specimens of New Hampshire's wild and cultivated plants, (3) exhibits of woods indigenous to the state, (4) specimens showing geological structure and mineral deposits, (5) models of geographical features, (6) exhibits illustrating prominent industrial and educational activities, (7) photographs and charts bringing out prominent scientific features of the state and scientific discoveries made by our citizens, etc

An academy library might house files of the reports and proceedings of state academies of science and of other similar organizations It might include scientific publications specially related to New Hampshire or to work being carried on by members of the academy A special section might be devoted to scientific works published by New Hampshire men It seems that academy museums and libraries should aim to present and emphasize the interrelations of the different fields of knowledge, especially the close relation between the welfare and happiness of our people and the application of scientific knowledge to every-day affairs. This is perhaps the main burden of the new humanistic revival that seems to be getting so well started throughout the world. It does not

seem generally desirable that such collections should to any great extent duplicate specimens or volumes already available nearby They might well bring out the various features of the wealth of their respective states. They might be very valuable in connection with the development of the industries of their states.

In a broader way, helping ourselves by cooperation with others, our New Hampshire Academy is surely ready to take part in activities aiming toward the general cooperation of the academies that are affiliated with the American Association for the Advancement of Science Because state academies of science are generally much alike in their organization and are confronted with similar problems, frequent and free interchange of ideas and experience would undoubtedly be beneficial to all There is a strong movement toward the realization of such cooperative interchange and that movement has been fully recognized by the American Association, which has already furnished valuable aid to the academies affiliated with it A special committee on academy relations has recently been formed, including representatives of all the affiliated academies and of the executive committee of the association We expect the new committee to study the problems of academy work and to make suggestions and inaugurate facilities for much progress in inter-academy relationships, making use of the already well-established organization of the American Association Each affiliated academy has a representative in the council of the association, being thus in direct touch with association affairs, and the academy secretaries are in close relation with the Washington office of the association The permanent secretary, Dr Burton E Livingston, has informed me that he is enthusiastic about the new academy movement and that the facilities of the Washington office are at the disposal of the affiliated academies in all feasible ways He has expressed the hope that the affiliated academies may soon become virtually local branches of the larger organizations They stand for the advancement of science in their several states in somewhat the same way as the association has so long stood in the country as a whole

Several tentative suggestions as to ways in which our New Hampshire Academy might cooperate with the other state academies and with the American Association are mentioned below, but it is clearly realized that considerable study by representatives of all the academies will be needed before such suggestions may be relatively evaluated

1. We might invite representatives of other academies to our meetings.

2. We might encourage our secretary to carry on correspondence with the secretaries of other academies, reporting interesting points and suggestions to our council or to our academy as a whole from time to time, perhaps occasionally through the *News-letter* if such an arrangement can be made

3 We might encourage a similar correspondence between our academy and the permanent secretary of the American Association Dr Livingston has said that he will be glad to do his part

4. We might aid the American Association to secure the attendance of official representatives of the association at our meetings The association has approved of such representation, but the plan has not yet been generally realized

5 We might arrange for occasional joint meetings with near-by academies if that proves feasible

6 We might aid the science workers of other states to establish state academies where there are none at present, hoping that newly-formed state academies might become affiliated in our group with the American Association

7 We might do what we can toward securing the general realization of the common aims of all the academies through inter-academy cooperation and with help from the association

With the "Backgrounds" shown us a year ago by Mr Foster in his presidential address, with a realization of what the New Hampshire Academy of Science has accomplished in the eight years of its existence, and with the courage and faith of a Lindbergh to turn the opportunities of to-day into the realities of to-morrow, let us say, as did Professor B S Hopkins, the discoverer of Illinium, in his inaugural address before the Division of Chemical Education of the American Chemical Society at the Richmond meeting last April "Hats off to the accomplishments of the past, coats off to the accomplishments of the future"

WILHELM SEGERBLOM

HESPEROPITHECUS APPARENTLY NOT AN APE NOR A MAN

IN February, 1922, Mr Harold J Cook, a consulting geologist and paleontologist of Agate, Nebraska, sent to Professor Osborn an isolated fossil molar tooth which he had found in the Snake Creek beds of western Nebraska He regarded it as closely approaching the human type and requested Professor Osborn and his colleagues to examine and describe it. After careful study and comparisons Professor Osborn published an article in the *American Museum Novitates* (April 25, 1922) entitled "*Hesperopithecus*, the First Anthropoid Primate found in America." In this brief article the author described the molar as the type of a new genus and species, which he named

Hesperopithecus haroldcooki, "an anthropoid of the Western World, discovered by Mr. Harold J. Cook."

In the type specimen the crown of the tooth had been ground off by long wear to such a degree that the surface of the crown was entirely gone and only the very basal portion was left. This presented an evenly concave surface of wear that was strikingly similar to the worn-down surface of one of the upper molar teeth that had been found by Dr. Dubois at Trinil, Java, near the famous skull top of *Pithecanthropus erectus* The Nebraska tooth also had a very wide root on the inner side, which was similar to the wide root on the inner side of the upper molars of *Pithecanthropus* and of many teeth of American Indians Hence Drs Gregory and Hellman, whose report was cited by Professor Osborn, were inclined to think that on the whole the nearest resemblances of the specimen were with men rather than with apes Professor Osborn stated that "this second upper molar tooth is very distant from the gorilla type, from the gibbon type, from the orang type, among existing anthropoid apes it is nearest to m² (the second upper molar) of the chimpanzee, but the resemblance is still very remote" After comparing it with the upper molars of the known fossil apes of Asia, as well as with the tooth of an American Indian, the author concluded that it was a new and extinct type of higher primate and that we must seek more material before we could determine its precise relationships to hitherto known races of men and of anthropoid apes. Professor Osborn also alluded to the fact that since 1908 there had been in the American Museum another badly water-worn tooth from the same formation and that Dr W D. Matthew had long been inclined to regard that specimen as pertaining to an anthropoid ape

The scientific world, however, was far from accepting without further evidence the validity of Professor Osborn's conclusion that the fossil tooth from Nebraska represented either a human or an anthropoid tooth Many authorities made the objection "Not proven," which is raised to nearly every striking new discovery or theory, and in course of time nine suggestions were put forward by responsible critics as to what the type specimen of "*Hesperopithecus*" might represent other than any kind of ape or man. Accordingly, Professor Osborn requested Drs. Gregory and Hellman to consider these suggestions and to present a more detailed report on the already famous specimens.

The first report of these authors is given in the *American Museum Novitates*, January 6, 1923 In their analysis of characters of the type they endeavored to distinguish four categories: (1) characters due to long exposure to weathering, erosion and stream action; (2) characters due to extreme natural wear of the crown; (3) chief characters that the *Hesperopithecus* tooth shares with both man and the anthropoid apes; (4) characters peculiar to *Hesperopithecus*. They published a series of photographic views in which the type specimen of *Hesperopithecus* was compared with upper molars of the chimpanzee, of *Pithecanthropus* and of the modern American Indian. They gave a table of measurements in which the dimensions and proportions of the type were compared with similar data for the molars of chimpanzees, of *Pithecanthropus* and of American Indian, concluding that the *Hesperopithecus* type on the whole came nearest to the second upper molar of a chimpanzee They also published a series of radiographs which showed marked resemblance in the pulp cavity and roots to both chimpanzee and Indian molars

In the second report by Drs Gregory and Hellman on the *Hesperopithecus* problem (published in the *American Museum Bulletin*, December 4, 1923) the chief results are that after extended comparisons the authors concluded that the specimen could not represent a lower molar of any carnivore, that none of the other suggestions as to its possible relationships had proved tenable, that the greater number of resemblances of the type appeared to be with the gorilla and the chimpanzee rather than with the orang It was also noted that "one of us (M. H) still regards the human resemblances as being of considerable significance, while the other (W K G) leans toward the anthropoid affinities of the type The range of variability in crown and root characters of the molars both in the Hominidæ (human family) and the Simiidæ (anthropoid ape family) is so great and so overlapping as to warrant either interpretation." In view of the foregoing, the authors concluded that the "exact generic diagnosis of *Hesperopithecus* must await further discoveries."

In the hope of discovering more remains of this highly interesting fossil, Professor Osborn sent Mr. Albert Thomson, of the Museum staff, to collect in the Snake Creek beds of Nebraska in the summers of 1925 and 1926. At different times Mr. Thomson was joined there by Mr. Barnum Brown, Professor Othenio Abel, of Vienna, Professor Osborn and the writer. Among other material the expedition secured a series of specimens which have led the writer to doubt his former identification of the type as the upper molar of an extinct primate, and to suspect that the type specimen of *Hesperopithecus haroldcooki* may be an upper premolar of a species of *Prosthennops*, an extinct genus related to the modern peccaries. Some of these teeth have the crown worn down and more or less similar to the type of *Hes-*

parapithecus, in others the crown is much less worn and directly comparable with the relatively unworn premolar crowns of *Prosthennops serùs* (a well-preserved palate of which had been discovered in an earlier expedition), while still others reveal more or less intermediate conditions. Moreover, the lower teeth which are apparently associated with these upper premolars are unquestionably the same or nearly the same as the corresponding lower teeth of *Prosthennops.* The still weak link in the chain of evidence consists in the fact that in *Prosthennops* the premolars that approach the type tooth of *Hesperopithecus haroldcookii* have two inner roots, whereas the type tooth has a single broad root

This apparent difficulty may perhaps be met by the hypothesis that the type specimen is a second upper premolar, a tooth which in *Prosthennops serus* has only a single root; on the other hand, the type is far larger than any known *Prosthennops* This much may be said Nearly every conspicuous character of the type can be matched in one or another of the *Prosthennops* teeth Thus, the concave wearing surface of the type is closely approximated in a certain worn upper molar of *Prosthennops*, the sharp ending of the enamel on the neck is seen also in the same specimen, the form and direction of the roots are closely paralleled in a third Another upper molar (found by Professor Abel) and identified by him as *Hesperopithecus*, in the light of later finds is demonstrably *Prosthennops.*

It is hoped that further exploration this summer (1927) will secure sufficient material to remove all doubt in this matter

Postscript

Last summer (1927) Mr. Thomson made further excavations in the exact locality where the type of *Hesperopithecus haroldcookii* was discovered A number of scattered upper and lower premolar and molar teeth were found in different spots, but every one of them appears to me to pertain to *Prosthennops*, and some of these also resemble the type of *Hesperopithecus*, except that the crown is less worn

Thus it seems to me far more probable that we were formerly deceived by the resemblances of the much worn type to equally worn chimpanzee molars than that the type is really a unique token of the presence of anthropoids in North America.

William K. Gregory
American Museum of Natural History

A NEW THEORY OF POLYGENIC (OR NON-MONOGENIC) FUNCTIONS

If we consider an independent complex variable

$$z = x + iy$$

and a dependent complex function

$$w = \varphi(x, y) + i\psi(x, y)$$

then in general the limit of the increment-ratio $\frac{\Delta w}{\Delta z}$ depends not only on the point (x, y) but also on the direction or slope m. The function is called *monogenic* in the classic case where the limit is independent of m, so that it has only *one* value at a point. I have proposed recently (in my lectures at Columbia University, and in communications to the National Academy and to the American Mathematical Society) the new term *polygenic* to describe the case where the limit has *many* values at a point, one for each slope Thus for a polygenic function the derivative is not a function of (x, y) or z, but of x, y, m. We write therefore the derivative in the form

$$\frac{dw}{dz} = \gamma = \alpha + i\beta = F(x, y, m).$$

We plot $z = x + iy$ in a first plane, $w = u + iv$ in a second plane, and $\gamma = \alpha + i\beta$ in a third plane

To each point in the first plane corresponds one point of the second plane, but ∞^1 of the third plane (which we also call the derivative plane)

The locus of these points is always a circle This is true for any polygenic function The equation of the circle is

$$(\alpha - H)^2 + (\beta - K)^2 = h^2 + k^2 = R^2$$

where

$$2H = \varphi_x + \psi_y, \qquad 2K = -\varphi_y + \psi_x,$$
$$2h = \varphi_x - \psi_y, \qquad 2k = \varphi_y + \psi_x$$

(In the special case where the function w is monogenic the circles of course all shrink to points, since in virtue of the Cauchy-Riemann equations h and k vanish so that the radius R is zero)

To the ∞^2 points of the first plane correspond ∞^2 circles (in general distinct), that is, a congruence of circles We call this the *derivative circular congruence* of the given polygenic function

Thus while the transformation from the first plane to the second plane is a point transformation, the passage from the first to the third plane gives rise to a contact transformation

Many noteworthy classes of polygenic functions are obtained by specializing the congruence. Thus if the congruence degenerates into the ∞^1 circles with the center at the origin, the function is of the form

$$w = f(x - iy)$$

that is an analytic function (power series) of the conjugate complex variable. If the circles all go through the origin, the components φ and ψ are dependent, that is the Jacobian must vanish. If the centers all lie on the axis of α, then we obtain the special form

$$w = W_x + iW_y,$$

where W is an arbitrary function of x and y. And so on.

Returning now to the general theory, we state this fundamental and easily proved theorem

As the direction or slope m varies at a given point of the first plane, the corresponding point γ moves on the derivative circle in the third plane so that its angular rate is always twice that of m and in the opposite sense.

Therefore the complete picture of the derivative $\frac{dw}{dz}$ is not a congruence of circles but a *congruence of clocks* Here I use the word *clock* to denote a circle with a particular distinguished radius vector We select this to correspond to the direction $m = 0$ at the point in the z-plane Thus a clock is completely determined by two vectors, namely the central vector $H + iK$ and the phase vector $h + ik$

From the above theorem it follows that there are just *three* directions m which are parallel to the corresponding radii of the derivative circle, and that these radii are spaced at intervals of 120°. Since this is true at any point, we obtain by integration a triple family of curves (which we call the *equiangular family*) in the first and third planes.

We next define the *mean derivative* of a polygenic function as the mean value

$$\frac{1}{2\pi}\int_0^{2\pi} \frac{dw}{dz}\, d\theta \text{ where } \tan\theta = m.$$

The result is found to coincide with the center of the derivative circle Hence, using the symbol $\mathfrak{D}$ for mean differentiation, we have this fundamental formula

$$\mathfrak{D}(\varphi + i\psi) = H + iK = \frac{\varphi_x + \psi_y}{2} + i\,\frac{-\varphi_y + \psi_x}{2}$$

We verify the symbolic equation

$$\mathfrak{D} = \frac{D_x - iD_y}{2}$$

where D_x and D_y denote partial differentiation We thus obtain easily positive and negative powers of this operator

The mean derivative of a monogenic function is of course a monogenic function The converse however is not true

The mean derivative of a polygenic function is sometimes monogenic This occurs when and only when φ and ψ obey Laplace's equation, that is, when φ and ψ *are any harmonic functions*

For this type of harmonic polygenic function, the transformation from the point $x + iy$ to the point $H + iK$, which we call the *induced center transformation* and denote by T', is conformal (direct), though the transformation T from $x + iy$ to $u + iv$ is in general not conformal. We shall call T in this case a *general harmonic transformation.* This class of transformations, which does not form a group, includes the total conformal group (made up of direct and reverse conformal transformations) as a special case.

Further developments of the general theory will be published in the Proceedings of the National Academy of Sciences, the Comptes Rendus, and the Transactions of the American Mathematical Society.

EDWARD KASNER

COLUMBIA UNIVERSITY,
NEW YORK

SCIENTIFIC EVENTS

REPORT OF THE PRESIDENT OF THE CARNEGIE INSTITUTION

THE trustees of Carnegie Institution of Washington met in annual session on December 9, Elihu Root presiding In recognition of the fact that the institution is completing a quarter century of activity, President Merriam, in his formal report covering the work of the institution for 1926–27, briefly characterized the policies of the quarter century

He said that in the first years the institution's grants were commonly made for specific projects to run for limited periods These covered a relatively wide range of subjects, affording an important stimulus to many types of agencies In later years the tendency developed to center upon major projects which required sustained effort and concentration of funds This tendency resulted in the development of departments in the institution's organization, each devoted to its specific subject and under leadership of an investigator of exceptional vision and ability Although the practice of giving minor grants to distinguished individuals for special projects was continued, in many cases advantage was found in relating such problems to that department of the institution best fitted to cooperate Still more recently a relation between departments has developed comparable to that which had developed in some instances between departments and individual investigators.

President Merriam summed up his observations on the institution's policy as it has evolved during the quarter century by saying

> The institution to-day contains all the elements that have arisen in the course of study of its problem. There are still widely distributed special grants. The greater departmental activities still represent concentrated effort in specific fields. The increasing mutual support has not diminished initiative of the individual or of the group, but it has added an element which with the passing of time becomes more and more valuable, both in effort to concentrate upon special projects and in keeping that view of the larger field so desirable in long-continued researches.

Plans involving an expanded program of activities in the fields of early American cultures and of plant biology were also referred to by the president

In respect to the first of these he said that the specific investigations heretofore undertaken by the institution in American archeology had been initiated in the hope that they might lead to some suggestion of laws which have governed in the development of the varying types of early peoples and cultures in America. He pointed out that the time had now come in the work of the Carnegie Institution in this field when the results should be interpreted in the light of what has been learned about the American problem in other regions and by other agencies

The president also stated that Dr Alfred V Kidder, who has worked with distinction in early American history and is deeply interested in the wider aspects of the matter, has accepted leadership for the institution in its broadened activities in this field of research This change implies no lessening of interest in the investigation of the Maya culture of Yucatan, for the results which the institution has obtained, he assured the trustees, amply justify adherence to its fundamental plan of furthering historical studies in Middle America

In referring to proposed changes in the plant biology program the president said that during the past two decades the institution had attempted to advance the boundaries of knowledge by intensive effort at several critical points along the margin of the field Such, he suggested, have been the researches in problems of life process in plant physiology, on the relation of life development to special types of conditions as in work at the Desert Laboratory, on the relation of life progress to environment, on problems of plant heredity, on questions touching relation of classification to heredity and to influence of environment and on problems presented by the history of plant life during the ages

In 1926 a small committee of the institution's leading investigators in this field was asked to formulate a program for future guidance after full consideration of the matter. The report of this committee, the trustees were informed, indicates that a greater unity of attack would be profitable to all, without real loss or hardship and that a larger measure of unity in administration would facilitate the entire plant biology program.

President Merriam also spoke of the opportunity afforded the institution's investigators during the year of participating in international meetings He believes that such meetings and the contacts with workers in related fields which they provide have distinct value. On this point he said:

Through these relationships there has developed both the accumulation of materials arising from studies by other institutions and the contribution from our own researches, which are thus subjected to constructive review by experts in related fields It is believed that such extension of our relationships is one of the important means to be used in finding how our own course should be steered in the unknown fields toward which we are always moving

Dr Merriam presented to the trustees a report covering in detail the progress of research carried on by the institution during 1926–27 This will soon be available for distribution in the form of *Year Book*, No 26

The trustees upon completing the business of the day spent the afternoon with their friends in viewing the exhibition prepared by members of the institution staff This exhibition, which is set up at this time every year at the Administration Building, Washington, D C, is designed to show the progress made in significant research activities For three days following the annual meeting of the board of trustees, December 10, 11 and 12, the public generally was invited to view the exhibits

EXPLORATIONS IN ALASKA BY THE U. S. GEOLOGICAL SURVEY

THE U S Interior Department announces the completion of the field work of another exploratory expedition in Alaska by the Geological Survey and the bringing back of maps and information regarding a tract of more than 2,000 square miles in the Alaska Range and adjacent country on the west side of Cook Inlet, in the environs of Mount Spurr, that has hitherto been shown as a blank area on all authoritative maps This exploration is one of the series that the Geological Survey has been making throughout the last thirty years The party consisted of S R. Capps, geologist in charge, R H Sargent, topographic engineer, and four camp men Transportation in the field of the necessary provisions, supplies and equipment for 100 days was furnished by a pack train of fifteen horses From the time when the party landed at Trading Bay, on the west side of Cook Inlet, about the middle of June, until it returned to that place at the end of the field season, about the middle of September, the members were entirely out of communication with the rest of the world

Among the many items reported are the discovery and mapping of a large river, numerous lakes, glaciers and mountains and an active volcano The newly discovered large river is the Chakachatna, whose drainage basin covers an area of more than 1,100 square miles. This stream is a roaring torrent far too swift and too deep to be forded even with horses, in fact, measure-

ments of its current at several places showed that it was flowing at an average speed of 15 miles an hour This river rises in a superb lake, Lake Chakachamna, 23 miles long, which is hemmed in between lofty mountains and impounded behind a great glacier that lies athwart the general trend of the valley. The distribution of the rivers that head against the Chakachatna can now be predicted with considerable assurance. Thus, to the south are rivers that probably flow in part into Lake Clark, to the west and northwest are tributaries of Stony River and of the South Fork of Kuskokwim River

Many of the mountain peaks are ragged pinnacles which could be climbed, if at all, only with great difficulty The highest peak of the region is Mount Spurr, which rises to an altitude of 11,000 feet and is clearly visible from the coast Although the flanks of this mountain are in large part covered with perpetual snow and glaciers, the mountain was found to be an old volcano that is still active When the weather was favorable a plume of steam could be seen rising from a point near its crest to a height of more than a thousand feet. This discovery therefore establishes Mount Spurr as the most northerly of the long series of known active volcanoes that occur at intervals along the west coast of Cook Inlet and extend westward into the Alaska Peninsula and Aleutian Islands

ENDOWMENT FOR THE ARNOLD ARBORETUM

Friends of the late Professor Charles Sprague Sargent and others interested in the Arnold Arboretum of Harvard University, in Jamaica Plain, on November 30 gathered at Sherry's Restaurant, New York City, to hear of plans for the completion of a $1,000,000 endowment fund for the arboretum The fund, about $600,000 of which has been raised since Professor Sargent's death last March, will be used to perpetuate the great botanical station as he had planned it About 500 persons attended the dinner, held under the auspices of the New York committee

David Fairchild, agricultural explorer in charge of foreign plant introduction for the U. S. Department of Agriculture; Professor Oakes Ames, present supervisor of the arboretum and successor to Professor Sargent, and the Right Reverend William Lawrence, formerly Bishop of the Episcopal Diocese of Massachusetts, were the speakers. All urged support of the arboretum, painting it as a vital part of the country's life and as a great power both in the economic world and for the beauty of the nation

It was announced on December 3, by Mr. J. P. Morgan, who is acting as treasurer, that since the opening of the New York campaign to raise part of the proposed $1,000,000 endowment fund for the arboretum, $109,250 has been contributed by New Yorkers

A gift of $50,000 to the fund has been offered by Edward S. Harkness, on condition that the New York committee match the $460,000 already contributed in Boston

New York contributors to the fund so far are Moreau Delano, $25,000; J. P. Morgan, $20,000, Mrs Harold I Pratt, $15,000; Mrs W. Bayard Cutting, $5,000; William Adams Delano, $5,000, T A. Havemeyer, $5,000, Mrs. James H Metcalf, $5,000; Charles A Stone, $5,000, William Nelson Cromwell, $2,500; Henry W. de Forest, $3,000, John E Aldred, $2,500, R W de Forest, $2,500 plus $500; J. N Jarvie, $2,500; anonymous, $1,000; Paul D Cravath, $1,000, Mrs. Max Farrand, $1,000, Mrs W. L Harkness, $1,000, Clarence Hay, $1,000; Charles Hayden, $1,000, G O Muhlfeld, $1,000; Anton G Hodenpyl, $500; Mrs Arthur Curtiss James, $500, Mr and Mrs A. R. Graustein, $500, Victor Morawetz, $500, W H. Bush, $250, O M. Eidlitz, $250, and Elihu Root, $250

THE FIRST MEETING OF THE COLORADO-WYOMING ACADEMY OF SCIENCE

The first meeting of the Colorado-Wyoming Academy of Science was held on November 25 and 26, at the University of Wyoming. The new organization has an initial enrolment of 166 members chiefly from the eight educational institutions of these two states.

Sectional meetings were held in the new engineering building of the University of Wyoming and forty-one papers were presented on chemistry, physics, botany, zoology, geology and social science. At the business meeting on the afternoon of the second day the constitution was formally adopted and the following officers elected.

Dr. Aven Nelson, University of Wyoming, *President.*
Dr O C Lester, University of Colorado, *Vice-president.*
Dr. L W Durrell, Colorado Agricultural College, *Secretary.*
Dr. E B Renaud, University of Denver, *Treasurer.*

Closing the session a banquet was given the members by the University of Wyoming.

SCIENTIFIC NOTES AND NEWS

Thomas Alva Edison has been elected an honorary member of the British Institution of Electrical Engineers.

Presentation of the Chandler medal by Columbia University will be made to Professor Moses Gomberg on December 15, when he delivers the Chandler lecture on "Free Radicals in Chemistry—Past and Present."

DR. WILLIAM J. MAYO, of Rochester, has been named a commander of the Royal Order of the North Star by King Gustav of Sweden.

PRINCE ALBERT DE LIGNE, ambassador to the United States from Belgium, conferred on Dr. Chevalier Jackson, chief of the bronchoscopic clinic at Jefferson Hospital, the Knighthood of the Order of Leopold, on November 22, at an informal luncheon in the Belgian Embassy, Washington, D. C.

AT the meeting of the British Chemical Society on November 8, Sir Joseph J Thomson was elected an honorary fellow of the society

THE Russian expert commission for the awarding of the Lenin prizes for scientific work has made awards to Professor A. N Bach for work in the province of biological chemistry, to Professor V P. Vorobyov, Kharkov, for work in anatomy, to Professor K. K Gedroits for work in agricultural chemistry and soil science, and the late Professor L A Chugaye for work in the affinity of precious metals

THE James Scott prize of the Royal Society of Edinburgh, for the period 1922–1926, "for a lecture or essay on the fundamental concepts of natural philosophy," has been awarded to Sir Joseph Larmor

THE Royal Meteorological Society has awarded the Symons memorial gold medal for 1928 to Professor Hugo Hergesell, director of the Aeronautical Observatory, Lindenberg, for distinguished work in connection with meteorological science The medal, which is awarded biennially, will be presented at the annual general meeting on January 18

ALEX DOW, of Detroit, has been elected president of the American Society of Mechanical Engineers, succeeding Charles M Schwab, chairman of the Bethlehem Steel Corporation Vice-presidents are John H. Lawrence, New York, E. A. Muller, Cincinnati, Newell Sanders, Chattanooga, Tenn, Paul Wright, Birmingham, Ala. The managers named are L. B. McMillan, New York, William A. Hanley, Indianapolis, Ind.; F. H. Dormer, Milwaukee, Wis

SIR CHARLES CLOSE, formerly director-general of the British Ordnance Survey, has been appointed by the council of the Royal Geographical Society president of the society until the anniversary meeting next June in succession to Dr. D. G. Hogarth, who died on November 6.

DR. ROBERT F. MEHL has been appointed superintendent of the division of physical metallurgy in the Naval Research Laboratory, not director of the laboratory as was incorrectly stated in the last issue of SCIENCE. Captain D. E. Theeleen is director of the laboratory and Commander E. G. Oberlin is assistant director.

THE University of Manchester has conferred the title of professor emeritus upon Professor R. B Wild on his retirement from the Leech chair of materia medica and therapeutics.

PROFESSOR SUSLOV, director of the Odessa Polytechnical Institute, has celebrated his seventieth birthday, in which the Odessa scientific circles largely participated.

LUDLOW GRISCOM has been appointed assistant director of the Harvard Museum of Comparative Zoology and has resigned from the assistant curatorship of ornithology at the American Museum of Natural History

DR WILBERT W. WEIR, associate soil technologist in charge of editorial work in the U. S Bureau of Chemistry and Soils, has resigned to accept a position with the Chilean Nitrate of Soda Educational Bureau, New York

PROFESSOR GROVER D. TURNBOW, head of the division of dairy industry at the University of California, has been given leave of absence to engage in commercial work.

AT Duke University, W. H Hall, professor in charge of engineering, has returned after spending his year of leave at the University of Wisconsin. Harold C Bird, who has been acting as professor of civil engineering during Professor Hall's absence, continues as professor of civil engineering.

DR. D C CARPENTER, associate chemist at the New York State Agricultural Experiment Station, who has been working for the past few years on the structure of the casein molecule, has been invited by Dr T Svedberg to make use of the centrifuge in his laboratory at the University of Upsala to ascertain the molecular weight of casein Dr. Carpenter sailed for Sweden on December 9, under the auspices of the International Education Board, and will spend the coming year with Dr. Svedberg.

PROFESSOR JAMES H. BREASTED, director of the Oriental Institute of the University of Chicago, which has six expeditions in the field in search of records of lost civilizations, left Chicago on December 5 to inspect the work now in progress. Professor Breasted, his son Charles and his secretary, R. J. Barr, sailed from New York on December 10.

DR. P. J. VAN LONKHUIJZEN, director-general of health of the Netherland East Indies, is in the United States inspecting methods of public health and disease control employed by the U. S. Public Health Service.

Dr. Tetsuo Inukai, professor of zoology in Hokkaido University, Sapporo, Japan, and Dr T G Ahrens, ornithologist of Berlin, Germany, are visiting the United States

Professor Kirtley F Mather, of the department of geology at Harvard University, will be in charge of an expedition composed of students from Harvard, Mount Holyoke, Northwestern, Clark, Oberlin and the Massachusetts Institute of Technology, which will travel to different points of geological interest in Europe next year This expedition, which will supplant the annual trip to some mountain range in America, will last for twelve weeks.

Dr Sigmund Fraenkel, professor of medical chemistry at the University of Vienna, delivered five public lectures on "The Theory of Synthetic Remedies" at the University of California, from November 21 to December 2 Professor Fraenkel has spent a month in the laboratories of the university, collaborating with Dr Herbert M Evans, of the department of anatomy, on "Studies on the Chemistry and the Secretions of the Endocrine Glands."

The Japanese correspondent of the *Journal* of the American Medical Association writes that Professor S Tashiro, of the University of Cincinnati, accompanied by Professor Gustave Eckstein, has been visiting his native land From the same university, Dr Martin H Fischer has gone to Tokyo and is to deliver lectures at different universities

During the second semester 1927–1928, beginning on February 8 and continuing until May 26, the department of botany at the University of Illinois announces two courses in plant physiology to be given by Professor W W Lepeschkin, of the laboratory of plant physiology, Charles University, Prague Professor Lepeschkin goes to the university as visiting professor, and will give half-time to his work in the department The program has been so arranged that he will have the beginning and end of each week free for lectures at other institutions Arrangement for such lectures may be made through the department of botany.

Professor Lafayette B Mendel, of Yale University, has recently given lectures on "Some Aspects of Animal Growth" at the following places. October 28, Society of the Sigma Xi, McGill University, December 3, Royal Canadian Institute, Toronto, December 5, Society of the Sigma Xi, Cornell University, Ithaca

Professor Dugald C Jackson, of the department of electrical engineering at the Massachusetts Institute of Technology, lectured before the Franklin Institute on December 8 on "Illumination in the Industries."

Professor Henry Norris Russell, of Princeton University, lectured on December 9 at Smith College on "What are the Gaseous Nebulae?"

Dr. Oscar Riddle, of the station for experimental evolution at Cold Spring Harbor, N Y, delivered a lecture at the Carnegie Institution of Washington on November 15 on "Internal Secretions in Evolution and Reproduction"

Dr Samuel R Detwiler, professor of anatomy in the college of physicians and surgeons of Columbia University, gave two lectures on December 6 and 7 at Cornell University on "The Application of Embryonic Surgery to Problems of the Development of the Nervous System"

The school of chemistry and physics of the Pennsylvania State College, in cooperation with the school of mines and metallurgy of the same institution, announces the second annual Priestley lectures, consisting of a series of five public lectures on "The Physical Chemistry of Metals and Alloys," by Dr Samuel L Hoyt, of the Research Laboratory of the General Electric Company, to be given daily in the chemistry amphitheater from January 16 to 20, inclusive, at 7 00 P M

A symposium in memory of Lister was given, November 30, by the section of historical and cultural medicine of the New York Academy of Medicine The speakers were Drs Thomas Archibald Malloch, George D Stewart, John Tait, Montreal, and Fielding H Garrison, Washington, D C

The amalgamation of the Röntgen Society with the British Institute of Radiology was formally completed at a joint general meeting of members of the two societies on November 17. We learn from *Nature* that Sir Humphry Rolleston was elected president for the ensuing session, with Sir William Bragg, Dr Kaye and Dr Knox as vice-presidents. The president, in his inaugural address, referred to the history of the two constituent bodies and sketched the possibilities of the widened scope of activity which should follow the amalgamation.

Lady Lyell of Kinnordy has presented to the department of geology of the University of Edinburgh valuable collections of minerals, rocks and fossils, together with cabinets for keeping them In addition, Lady Lyell has given many geological books, papers of historical interest and a collection of autographed letters from scientific workers of note to the late Sir Charles Lyell.

A correspondent writes that the first fascicle of a work presenting the plants of China, entitled "Icones Plantarum Sinicarum," has been issued by the South-

eastern University at Nanking. The authors are Hsen-Hsu Hu and Woon-Young Chun. The large size (48 x 31 cm.) makes the handsome plates unusually impressive. This first fascicle is dedicated to Charles S Sargent in memory of his interest in the woody flora of China The fascicle contains fifty species and plates, the descriptions being in both English and Chinese

THE chairman of the general committee of the American Society for the Control of Cancer has announced the completion of the society's $1,000,000 fund for which a campaign was started a year ago The endowment will insure a minimum budget of $60,000 a year to continue the society's work At the same time, Dr George A Soper, managing director of the society, announced that its educational bulletins had been published daily for the last two weeks in one hundred and twelve newspapers throughout the country

NATURE states that members of the British Association have from time to time discussed the desirability of the association's applying for a royal charter It has been felt that the association would be strengthened in its work for the advancement of science by the possession of a charter, but the cost involved has hitherto acted as a deterrent Mr A A Campbell Swinton has now generously offered to bear this cost, and the council has resolved to recommend the general committee to accept this offer and to authorize the president and general officers of the association to apply for a charter on its behalf The possession of a charter would, moreover, enable the association readily to avail itself of a proposal made by Mr George Buckston Browne, who, it will be remembered, offered to purchase Darwin's house at Downe for the nation, in response to the appeal made by Sir Arthur Keith in his presidential address at the Leeds meeting of the association. Mr Buckston Browne has now expressed his desire that the trusteeship of the estate should be vested in the association, and the council will recommend the general committee to accept this further generous offer

AN endowed fellowship for advanced astronomical students has been provided at Harvard through a gift to the observatory from Mr. George R Agassiz, chairman of the Observatory's Visiting Committee. According to *Popular Astronomy* the holder of the fellowship is expected to carry on his researches at the Harvard Observatory, and preferably will be a candidate for a doctor's degree in Harvard University. The annual stipend will be not less than one thousand dollars. The present holder of the Agassiz research fellowship is Mr Frank S. Hogg, B A., Toronto, who has made investigations in stellar spectrophotometry at Harvard University during the past year

IN the new quarters into which the department of physiology of the University of Chicago has recently moved, there is about three and one half times more space available for teaching and research than in the old building At the present time thirty-seven individuals are engaged in research in the department Aside from the teaching staff, research associates, volunteer workers, and graduate students specializing in physiology, there are eleven workers holding fellowships These are distributed as follows 3 Rockefeller Foundation fellows, 1 National Research Council fellow, 2 Douglas Smith Foundation fellows, 1 Seymour Coman fellow, 1 Donnelly fellow, 1 Hille fellow, 1 university fellow and 1 Sidney Walker, Jr, scholar

THE museum of natural history of the University of Iowa, for many years an adjunct of the department of zoology, is now an independent unit, designed to meet the needs of the different departments and also those of the general public By action of the president of the university, Professor Homer R Dill has been made director of this new department For a number of years Professor Dill has been director of the vertebrate museum

ACCORDING to *Museum News*, the Fleischmann mammal wing of the Santa Barbara Museum of Natural History will be opened to the public for a week during the Christmas holidays As only a part of the exhibits which are planned for this new addition can be in place at this time, it will be necessary to close the building again for further work, before the collections can be permanently placed before the public Three large California habitat groups will be completed by Christmas These include the mountain lions, California mule deer and coyotes. When the wing is permanently opened there will be other groups of tree squirrels, striped skunks, badgers, bob cats and foxes found in the state of California.

THE Brussels correspondent of the London *Times* writes that, on the initiative of King Albert and the great industrialists and financiers, a movement has begun for the creation in Belgium of a permanent museum and a laboratory for scientific research, which it is proposed to develop into a center of study, where all nations will be invited to exhibit in 1930 the best specimens of scientific equipment. An academic session, attended by the king, the ministers and the diplomatic corps, was held on November 25 at the Palais des Académies in Brussels to consider the opening of a national fund for scientific research. In his speech King Albert said that, though science created wealth, it was itself poor They must come to its aid, in order

that scientific effort might develop in Belgium with as much freedom and vigor as in other countries. Men of science should be relieved of material cares, and thus be placed in a position to concentrate all their thoughts on research Many gifts have already been announced.

According to a statement made in the report of the French National Committee for Geodesy and Geophysics of the General Assembly held on June 8, 1927, that committee has decided to purchase an apparatus for the determination of gravity at sea similar to the one used for that purpose by Dr F A. Vening Meinesz, engineer of the Dutch Geodetic Commission, who has determined gravity at sea on a submarine while making a voyage from Holland to Java, by way of the Mediterranean, and a voyage from Holland to Java, by way of the Panama Canal

Intensive study of the effect of medicines on the human body will be made at a new research institution for internal medicine to be established by the Kaiser Wilhelm Society at Heidelberg, according to the German correspondent of the American Chemical Society. Among the investigators who will work on the staff of the new institution will be Professor L. Krehl, of Heidelberg University, specialist in international medicine

According to *Nature* the Slutzk, better known under its original title, Pavlovsk, observatory for meteorology and geophysics, celebrated on December 4 the fiftieth anniversary of its foundation Well equipped with magnetic instruments designed by its first director, H. Wild, and for many years the most northern magnetic observatory in the world, Pavlovsk has supplied a long series of magnetic results, which have been utilized in many researches by foreigners as well as Russians. Observations in atmospheric electricity, begun in 1913, have supplied data of much interest in connection with the vexed question of the true nature of the diurnal variation of the potential gradient Actinometry has also had a special place in the program of the observatory during the present century Aerological work in Russia had its origin at Pavlovsk some thirty years ago, but it is now provided for in a separate institution Foreign participation is invited in the approaching ceremony.

The Berlin correspondent of the *Journal* of the American Medical Association writes that an exposition on human nutrition will be held in Berlin, from April 28 to August 5, 1928 The exposition will have to do chiefly with the scientific and practical demonstration of a suitable mode of nutrition involving only a reasonable cost. According to the plan of the exposition as tentatively announced, the main departments of the exposition will comprise: (1) the basis of nutrition; (2) food products, the technic of food products and the food products industry, (3) nutrition in practical life, and (4) education, instruction and literature pertaining to nutrition.

The William H Coleman Hospital for Women, Indianapolis, was opened on October 20, and formally presented to the University of Indiana by Mr. and Mrs. William H. Coleman, who gave more than $350,000 to build and equip the hospital as a memorial to their daughter.

President Coolidge has signed a proclamation segregating the Ocala division of the Florida National Forest as the Ocala National Forest. The new Ocala National Forest will have a separate administrative organization. Florida now has two national forests. The creation of the Ocala National Forest as a separate unit will further the growing of timber on the sandy soils, the protection of the area against fire, and the improvement of the area for recreational purposes Game laws will be administered in cooperation with the state game department. The Ocala forest has a gross area of 252,000 acres, of which 158,622 are owned by the United States.

A grant has been voted by the legislature toward the expenses of a malarial survey of Jamaica, to be conducted by the International Health Board of the Rockefeller Foundation

A base map of certain parts of the Mississippi basin, to be used in the study of flood prevention in the river region, has been issued by the U S. Geological Survey. The territory embraced in the map extends from Dubuque on the north to the Gulf on the south, and from Omaha, Tulsa and Houston on the west to Chicago, Evansville and Tuscaloosa on the east.

The London *Times* reports that the following communication received from the Selborne Society, signed by Lord Montagu of Beaulieu (president), Lord Avebury (vice-president) and Sir John Otter (treasurer), states: "Adjoining the Brent Valley golf links, in the Borough of Ealing, is an estate of seven acres, the greater part of the grounds of which have, from being left almost entirely untouched for 15 years or more, become a recognised haunt of birds, and many species are known to have nested there. These include the blackcap, the garden and willow warblers, the whitethroat and the moorhen. Wildfowl come to the lake which is formed by the perennial spring, and the goldfinch and green woodpecker are often to be seen. The Selborne Society has long wished to protect the ground in question, and at last there is an opportunity of acquiring it. It has been suggested that it would make a fitting memorial to the late W. H. Hudson, who helped the Selborne Society to establish the Brent Valley Bird Sanctuary

at Perivale, higher up the river, which, 25 years ago, set an example that has been widely followed of preserving for urban districts the interesting birds of the countryside. It will not be necessary for the Selborne Society to take over the mansion, but if funds allow, as this has been fitted up as a hospital by the government, two good things might be done at once, for it could most appropriately be placed at the disposal of some charitable organization, or it could be used as the beginning of a folk museum, which ought to be inaugurated in this country before it is too late The property was advertised as for sale by auction in building plots a few days ago, but some members of the Selborne Society have, for the moment, saved it from this fate. Donations can, therefore, now be invited towards its purchase and maintenance, which should be sent to the treasurer, Sir John Otter, at the Hermitage, Hanwell, W.7"

UNIVERSITY AND EDUCATIONAL NOTES

NORTHWESTERN UNIVERSITY, which has announced plans for extensive improvement of its downtown campus, is preparing to add to its Evanston, Ill, campus a $750,000 union building

DR FRANK VINSONHALER, professor of ophthalmology at the school of medicine of the University of Arkansas, has been made dean of the school

H. W. VAUGHAN, professor and animal husbandman in charge of beef cattle investigations in the University of Minnesota, has been appointed head of the animal husbandry department at the University of Montana.

JOHN LESLIE HUNDLEY, of the University of North Dakota, has been appointed assistant professor of physics at Tulane University

E. D. COON has returned to the University of North Dakota as assistant professor of chemistry, after having spent a year's leave of absence at the University of Wisconsin, working under the direction of Professor E. O. Kraemer in colloid chemistry

IT is stated in *Popular Astronomy* that Harry H. Plaskett, of the Dominion Astrophysical Observatory at Victoria, B. C., has been appointed lecturer in astrophysics in Harvard University, beginning February, 1928. A leave of absence for one year has been granted Mr. Plaskett by the Canadian government.

DR. OTTO STRUVE, of the Yerkes Observatory, University of Chicago, has been promoted to an assistant professorship of astronomy.

DR. D. S. VILLARS, who spent the past year at Göttingen in the laboratory of J. Franck, has been appointed associate in chemistry at the University of Illinois.

THE title of professor of chemistry in the University of London has been conferred on Dr J. F Spencer, in respect of the position held by him at Bedford College

SIR EDWARD FARQUHAR BUZZARD has been appointed Regius professor of medicine in the University of Oxford from January 1, 1928, in the room of Sir Archibald Garrod, who has resigned.

DISCUSSION AND CORRESPONDENCE

THE PHYSICIST AND THE FACTS OF COLOR

THERE is probably not a single physicist who has gone so far in the analysis of his color-sensations as to know that the violet, which plays such an important rôle in his list of colors, is not a unitary color at all, but plainly a "dual color blend" of some red and more blue It can be got not only by a certain homogeneous light-frequency, but also by a physical mixture of some red light and more blue light It no more deserves a separate enumerating than do the other dual color blends, *viz*, the blue-greens, the yellow-greens, the reddish-yellows and the bluish-reds (what we also call the purples) In Figure 1 is

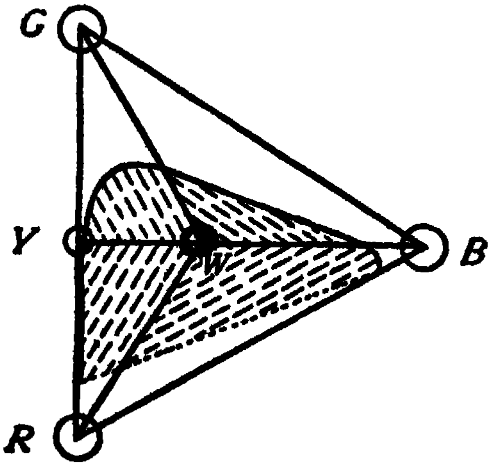


FIG 1. The *quadrigeminal* color area—*triangular* in shape.

illustrated at once the two fundamental facts of color-vision: (1) the Young-Helmholtz fact that vision consists in a tri-receptor initial process (it is sufficient to put into your color-mixing-apparatus three fundamental light-frequencies—those which look to us red, green and blue); and (2) the Hering fact that vision (when it comes to sensation) is nevertheless tetrachromatic—there are four chromatic sensations—Yellow is just as good, just as striking and just as unitary a sensation as are Red and Green and Blue. (I write these names with capitals when the colors which

I refer to are unitary) Figure 1 and Figure 2 are two different ways of representing diagrammatically the fundamental facts of color-vision—the fact of "matching by mixture" and the fact of tetrachromatism. Figure 1 represents the Thomas Young color-triangle with the introduction of definite points (circles) for yellow and for white. Vision is made up of all possible blends (some thirty thousand in all) of five unitary sensations—one achromatic (white) and four chromatic, which are, in the order of their development, Yellow and Blue, Red and Green. (When Hering chose his red and green, since it was essential to his theory to make them complementary colors, he took a bluish red and a bluish green—what I shall write as R_b and G_b. These colors are indeed complementary—R and G *and* B are (in the right proportions) a "white-constitutive" combination (triad)—but it is only by a curious illusion that his colors can be thought of as red and green.[1] This illusion, however, imposed upon his readers by Hering, he has been tremendously successful in inducing in the minds of his followers for some seventy-five years.

But it is one of the very numerous misfortunes that beset the subject of color that the spectrum, which would have been much more easily understood if there had been a simple blue at the high-frequency end, in reality shows there a recrudescence of the red with which it begins. A diagram of the course of the three initial-process curves is given in Fig. 2.

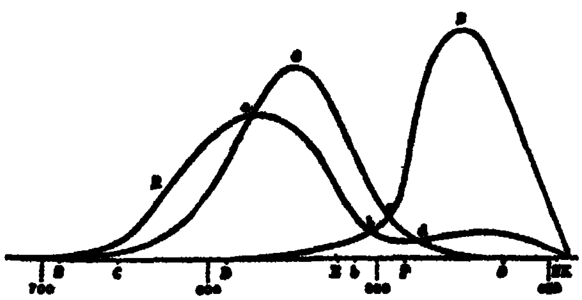


Fig. 2. R, G and B distribution curves. These are the curves of König and Dieterici, in their final corrected form. Abscissae, wave-lengths of the interference spectrum of the arc light, ordinates, arbitrary scale.

Diagrams have been laid down for the (four) distribution curves of the Hering colors also, but they are all purely the work of the imagination (*Am. Journal of Physiology*, **32**, 30, 1913). The Koenig-Helmholtz curves, on the other hand, are the product of an enormous amount of work in "matching the spectrum by mixtures of light-frequencies," carried out by Koenig in the Helmholtz laboratory. These curves have also been magnificently confirmed by their coincidence, respectively, with the two types of chroma-blindness, the deuteranopic (that of the vision of the human mid-periphery) and the protanopic (the color-vision of the bees), defective human vision (what every twentieth man you meet has got) is about equally divided between these two types.

On the other hand, we have much to be thankful for that, except for this second maximum of the red, the three curves are as simple as they are—they might have been so complicated as to be quite unravelable. It is also fortunate that they are only three in number, and not four even, in spite of the fact that the different chromatic sensations that they end in producing are four and that the light-sensations in all are five—white also is a color but an achromatic one. No reason is known for the second maximum of red, but of course no reason is known for the shape of any of the three resonance curves.

On the other hand, the physicist, who makes so much of violet, is capable of wholly overlooking the fact that there is another color in the spectrum (and in the world) which there is every reason for mentioning—it is in fact the most brilliant color of them all, *viz.*, yellow. It is true that all you need to put in in order to produce, by mixing, the complete spectrum is red and green and blue, but if you would only take the trouble to look at this spectrum which you have produced, you can not fail to see that while two of the dual chroma blends which you might expect[3] are indeed present, the third (what should be the red-greens) is conspicuous by its absence, and not only is that the case but something else—something entirely new, not in the least resembling a reddish green or a greenish red—has jumped in to take their place. It is exactly the same as if, on mixing in your test-tube a certain proportion of hydrogen and chlorine they should both of them absolutely vanish, and their place should be taken by a hydrochloric acid which has no trace of any of the properties of either of its constituents. Of its constituents, we say! Ever since the discovery of chemistry by Lavoisier magical events of this sort are no longer magical—we say at once, when properties perform this dance of disappearing and reappearing, that "a chemical reaction has taken place." Then why avoid employing the same term and making use of the same conception when (1) red and green vanish and have produced yellow, and (2) yellow and blue vanish and have produced white—especially since, if you look at the development of the color-sense, yellow is seen to be the color which red

[1] The real red and the real green, when mixed, give yellow, as every physicist knows.

[2] See Appendix on The Nature of the Color Sensations, in Helmholtz, Physiological Optics (English translation) II, 468.

[3] The blue-greens and the red-blues.

and green were developed out of, and white (at a still earlier time) the color which yellow and blue were developed out of? Does the great discovery of Lavoisier—the occurrence of the chemical reaction—exist for the color-physicist in vain?[4]

Violet is a popular but unscientific name for a slightly reddish blue, as any one can see by giving the matter a moment's attention A child can perform this analysis. My little girl, when three years old, stopped on the street—her scientific curiosity aroused—when she saw for the first time a brilliant purple surface, and exclaimed "Bu!—wed!—wed!—bu!" This is proof positive—what the Eskimos have also furnished proof of—that purple really is at once blue and red or red and blue. And yet a physicist even at the present day (Frank Allen) can propose a theory in which violet (a red-blue) is a fundamental color—that is, a sensation which is assumed to have a single physiological correlate attached to it! And Professor Knight Dunlap has proposed a theory (*The Psychological Review* **22**, 99, 1915) which he seems, however, not to have insisted upon in later years, in which the elements assumed are mauve, peacock and yellow (in other words, red-blue, blue-green and green red)! The fundamental principles which make such an assumption as this quite impossible have been admirably set forth by Professor G E Mueller (*Zeitschrift f Psych 10*, 2, 321, 1896)

But color is a subject in which the physicist is very apt to engage in fallacies. So distinguished a scientist as Professor Millikan is capable, when speaking of color, of committing a plain "wrong conversion," as the logician has called it He says (textbook on Physics, by Millikan and Gale) after having shown that white light can be separated up into all the colors of the spectrum, "we have shown that white light is composed of all the colors of the spectrum." But in fact white light is composed of red, green and blue, or—just as well—by the mixing of the most homogeneous obtainable yellow and blue light rays, it is not at all necessary to put in all the blue-greens, the green-yellows, etc, nor even yellow. Moreover, white can be seen *at every point of the spectrum* (with no mixing whatever) in these several (additional) cases:

B The normal eye (*a*) in a faint light,
(*b*) in the extreme periphery of the retina,
(*c*) when a minute point is looked at,

C The totally chroma blind,

D The lower animals (below the bees).

[4] See "Tetrachromatic Vision and the Genetic Theory of Color." SCIENCE, *55*, 555–560, 1922.

Until the physicist can be persuaded to give his attention to such facts as these, he will never be able to speak with intelligence on the subject of the color-sensations But the case is not altogether hopeless. Professor Peddie has said in *Nature* (July 18, 1925) that the theory which I have proposed for holding together all these very complicated facts—the genetic theory of color—"may well turn out to be the real state of things", and Professor Crew, in the new edition of his "General Physics" has used it as the *cadre* in which all these facts can best be understood The physicist is recommended to read Professor Crew's exposition

CHRISTINE LADD-FRANKLIN
COLUMBIA UNIVERSITY

ADDITIONAL RECORDS OF THE OCCURRENCE OF THE FRESH-WATER JELLY-FISH

THROUGH the kindness of the Bureau of Fisheries the following communication and specimens of this fresh-water medusa were brought to the attention of the National Museum

July 30, 1927

The Commissioner,
U S Bureau of Fisheries,
Washington, D C

Dear Sir

Inasmuch as the organism Craspedacusta is considered so rare according to Ward and Whipple in their "Fresh-Water Biology," I would like to take this opportunity to let you know that we have found our Slow Sand Filters swarming with the Medusa form of above, and specimens taken into laboratory are apparently thriving on the organisms in raw water Our supply is fresh water taken from above Great Falls above tidal water possibilities and I would appreciate if you could tell me where their source might be

This is the first time this organism has ever been noted here in our twenty three years' operation

Very truly yours,
(Signed) CARL J LAUTER,
Chief Chemist

Mr Lauter tells me the medusae he brought to the Bureau of Fisheries on July 30 were first noticed on July 28, and that they occurred at one time or another thereafter in practically every bed.

Each filter-bed is about 200 feet square and about four feet of water above the level of the sand. The beds are virtually in total darkness and there is very little circulation of air. The temperature of the water at this time of the year differs but little from that of the open storage reservoir from which it is drawn. At 8 A. M. on August 17 the temperature of the water at the surface in the filter was 74° F.

and in the open reservoir 75° F., August 18 at about 11 A. M. air temperature outside 71°, water in open reservoir 73° F., and in filter-bed 75° F. The water is slowly admitted to each bed through a main, discharging about 3 million gallons per day.

Bed No. 8, examined August 9, seemed crowded with medusae When the door of the bed was opened, the jelly-fish hastened to the light from all directions. There were literally thousands in sight at one and the same time. Though still present in this bed on August 12 and 13, not a single one was noticed on August 14 even after vigorous churning of the water. In fact, none were noticed in more than half a dozen beds opened that day Late the same afternoon a few were found in Bed No 7, where on the morning of August 15 over a hundred were secured. A few days later, so far as known, the medusae had completely disappeared.

In their exceptional appearance and sudden disappearance these specimens ran true to form, but in this case at least attention must be called to the fact that during the period that the medusae were found in the filtration plant the water eight miles above this point was not being alum treated, though their sudden disappearance did about coincide with its resumption on August 19 Mr Lauter assured me, however, that traces of alum are never found in water entering the beds This would seem to indicate that the medusae had entered the filters with the inflowing river water, but as they were not noticed at any time in either of the two open storage reservoirs through which the water entering the system passes, the medusae may have originated coincidentally from "microhydras" within the filter-beds. However, scrapings of the side walls, the surface sand, and a plank walk extending from the entrance door down to the surface of the sand, of a freshly drained filter-bed in which medusae had been found, failed to reveal any trace of the hydroid generation On the other hand, the well-known hydroid *Cordylophora lacustris* Allman was found abundant, thus adding another strictly fresh-water record to its occurrence in the United States.

A newspaper mention of this phenomenon resulted in a communication to the museum by Mr J. W. Keys, of Washington, D C., who reported seeing jelly-fish in two connected pot-holes on the Virginia shore of the Potomac near Great Falls. He first observed them on August 7, and again on the twenty-first, but by the time of his third visit to the place, about September 1, they had vanished.

Dr. H. B. Bigelow, of the Museum of Comparative Zoology, kindly determined the medusae as *Craspedacusta sowerbii* (Lankester). In North America the species has been found several times in the eastern United States and at one locality in the middle west.

The first fresh-water jelly-fish recorded from the United States was observed by Edward Potts,[1] who gave it the name of the hydroid from which he had seen it budded off, *Microhydra ryderi*. It appears to be a juvenile stage of *Craspedacusta sowerbii*, which name takes precedence by right of priority. The hydroid form had been taken from the rocky bed of a mill stream, Tacony Creek, near Philadelphia, and later also found prevalent along the Schuylkill River.

The year before Potts made his last report on this jelly-fish it appeared in a greenhouse aquarium at Shaw's Lily Pond, on the outskirts of Washington, D C, as recorded by the late Prof. C. W. Hargitt.[2] These aquaria have not been in use for a number of years and there is no recollection by present generation of Shaws that they ever recurred since the original find

On a number of different occasions, most of which were made public through these columns, Prof. Harrison Garman[3] has found *Craspedacusta* in great numbers in Benson Creek, Kentucky.

Meanwhile, Dr R E. Coker discovered some specimens in an artificial pond at Augusta, Georgia. These are mentioned in the only complete account of the development of the medusa since the studies made by Potts on the younger stages, by Prof. Fernandus Payne[4] under the name *Craspedacusta ryderi* He had abundant material over a period of years from 1918 to 1924, from an artificial body of water, Boss Lake, near Elkhart, Indiana.

Since the foregoing was written, Mr. Henry S. Barton, of Owensboro, Kentucky, has presented the National Museum and the Bureau of Fisheries with a number of specimens of *C. sowerbii* he had taken in "Indian Lake," August 21. This body of water presumably is near Owensboro, and the latter is about 120 miles to the westward of Benson Creek where Dr. Garman found the first Kentucky specimens. Their transparency, short life and unsubstantial constitution, together with conditions under which they occur in nature render it difficult and often impossible for the casual observer to notice their presence in any body of water. Garman says "The best conditions, judging by the character of the three seasons when it has been found [in Benson Creek], are settled, clear days, when the water is low, free from silt, and there is little current in the creek," and it should be added, during August and September. It may be that the appearance of this jelly-fish is as sporadic

[1] *Amer. Nat.*, Vol. 31, 1897, p. 1032, and *Quart. Jour. Micros Sci*, N S., Vol. 50, pt. 4, No. 200, 1906, pp. 623–633, also *Del. County Inst. Sci. Proc.*, Vol. III, no. 3, 1908, pp. 90–106.

[2] SCIENCE, Vol. XXVI, 1907, p. 638, and *Biol. Bull.*, Vol. XIV, 1908, pp. 304–318.

[3] SCIENCE, Vol. XLIV, 1916, p 858; Vol. LVI, N. S., 1922, p. 644; Vol. LX, N. S., 1924, p. 477.

[4] *Jour. Morph.*, Vol. 38, no. 3, 1924, pp. 387–411.

and irregular as that of *Apus* in many parts of the world.

From the accumulated records one can not but be convinced that *Craspedacusta* and its alternative generation are much more common and widely distributed in the fresh waters of the eastern and eastern central United States, at least, than heretofore believed, and that continued and careful examination of particular bodies of water over a period of years will prove this to be the case.

WALDO L. SCHMITT

U. S NATIONAL MUSEUM

THE MAGNETO-OPTICAL EFFECT AND THE ZODIACAL LIGHT

IN SCIENCE for October 21, 1927 (Vol 56, page 376), Dr. Elihu Thomson publishes a new hypothesis to explain the zodiacal light Some years ago he noticed that the particles of iron from the smoke of an arc were oriented by a magnetic field, so as to reflect light strongly in certain directions He suggests that the zodiacal light may be due to particles of iron oriented by the earth's magnetic field

The zodiacal light is a faint illumination seen in the west just after twilight, or in the east just before dawn. It is always centered on the ecliptic, or plane of the earth's orbit, being brightest just above the haze which nearly always dims anything seen near the horizon The brighter portions of the zodiacal light are distinctly more brilliant than the milky way. Spectroscopic tests indicate that it is simply sunlight, and it is fifteen or twenty per cent polarized, as would be expected after reflection

The generally accepted hypothesis may be summed up in Moulton's words "It is universally agreed that the zodiacal light is due to a great swarm of small bodies, or particles, revolving around the sun near the plane of the earth's orbit These small bodies are in reality planetesimals which have not been swept up by the planets, ..." The new Russell-Dugan-Stewart text on astronomy presents this hypothesis with the introductory statement "The observations make it almost certain that . . . ."

Although ordinarily not seen to extend more than ninety degrees from the sun, tests at Mt. Wilson have shown that some illumination extends over the entire sky. Keen eyes can, under the best conditions, discern a faint patch of light at the point on the ecliptic directly opposite the sun. This is known as the gegenschein. The swarm of small bodies must extend in appreciable numbers well beyond the earth's orbit. Particles opposite the sun would be seen at the "full" phase, like the full moon. The gegenschein is further explained by the fact that the combined attraction of the earth and sun tends to concentrate such particles in a sort of dynamic whirlpool about a point nearly a million miles outside the earth's orbit.

The fact that iron lines are conspicuous in the solar spectrum, and that iron is an important constituent of meteorites, suggests that iron particles may be numerous among those reflecting to us the zodiacal light, but the following observational evidence indicates that Dr Thomson's effect is unimportant.

(1) The zodiacal light is most conspicuous just outside of twilight, perhaps 30 degrees to 40 degrees from the sun, and ordinarily fades into invisibility before 90 degrees is reached The Thomson effect would produce the glow at 90° to 150° from the sun.

(2) The zodiacal light is always seen along the ecliptic, or plane of the earth's orbit The orbits of all the major planets are nearly in this plane. The Thomson effect depends on the earth's magnetic field, and so, in general, would not follow the ecliptic.

(3) As the earth's shadow extends to more than three times the distance of the moon, the gegenschein, or glow at the point opposite the sun, must be produced by particles which are presumably too distant to be oriented by the earth's magnetic field. Particles as near as the moon would, in that direction, be within the shadow of the earth and, therefore, invisible.

C C. WYLIE

UNIVERSITY OF IOWA

THE INDIGENOUS NATIVE POPULATION OF ALGERIA IN 1926[1]

IN a recent book[2] the indigenous native population of Algeria was studied in considerable detail, as the only example known to me of a human population which had virtually completed an entire logistic cycle of growth within the period of census taking. To the counts of this population made by the French between the years 1851 and 1921 inclusive, there was fitted, by least squares, the logistic curve

$$y = 2\,238 + \frac{3.141}{1 + e^{1\,2059 - 0\,4232x}} \qquad (1)$$

with the results shown in Table 1 for the years 1881 to 1921 inclusive, during which period the observed figures may be regarded as substantially reliable.

There have now come to hand[3] the results of the 1926 census of Algeria. It appears that the indige-

[1] From the Institute for Biological Research of The Johns Hopkins University.

[2] Pearl, R. The Biology of Population Growth. New York (Alfred A. Knopf), 1925. Pp. xiv + 260.

[3] *Jour. Soc. Stat. de Paris*, November, 1927, p 291.

TABLE 1

Observed Indigenous Native Population of Algeria and Fitted Logistic Curve

Year	Observed populations	Calculated populations from logistic curve	Percentage deviations of calculated from observed values
1881	2,842,497	2,962,000	+ 4 05
1886	3,287,217	3,224,000	− 1 95
1891	3,577,063	3,529,000	− 1 36
1896	3,781,098	3,859,000	+ 2 02
1901	4,098,355	4,184,000	+ 2 06
1906	4,477,788	4,478,000	± 0
1911	4,740,526	4,723,000	− 0 38
1921	4,924,938	5,060,000	+ 2 67

nous native population in that year was in total, 5,192,426.

The logistic curve shown in equation (1) was calculated on the basis of the data up to and including 1921 Extrapolating that curve it gives for the expected or probable magnitude of the indigenous native population in 1926 the value 5,162,000 This underestimates the population actually observed in 1926 by 30,426. This is a percentage error of only − 0 59 per cent To miss by just over one half a man in each hundred counted is certainly not a serious discrepancy Probably few demographic experts would care to assert that the error made in counting a population, however highly civilized, is less than six tenths of one per cent

The chief point of general significance in this result is that it makes still more valid the case of the native population of Algeria as an example of a human population following the logistic curve in its growth.

In closing I should like again to emphasize, as has been done repeatedly in what I have written on population growth, that the data in hand permit no prediction as to whether the native population of Algeria (or any other population) will in the future continue to follow its past logistic curve in its growth. All that the logistic theory of population growth is capable of saying on the point is that this result is to be expected only if the same forces, economic, social, geographical and possibly other, which have influenced the birth and death rates during the past history of the population continue to operate unaltered in the future, but not otherwise. If any or all of these factors undergo any considerable alteration in the future the course of population growth may be expected to depart from the particular logistic curve which it has followed hitherto

Raymond Pearl

SCIENTIFIC BOOKS

Recent Advances in Haematology. A Piney, M.D., P Blakiston's Son & Co, Philadelphia, Pa, 1927.

The author of this welcome and timely book, dealing largely with clinical hematology, very properly bases his interpretations of blood pathology on the data of normal blood development and those of the normal histology of the several hemal formative organs, yolk sac, liver, spleen, lymph nodes and bone marrow This is an approach to an understanding of the leucemias and primary anemias that seems to offer the most promising results In future a still more adequate attack will be made by way of the evolutionary history of blood and the hemopoietic tissues Information already at hand emphasizes the vastly greater genetic significance of the lymphocyte than is now generally accorded this hemal outcast For a work of this sort, properly a fairly inclusive digest, the discussions and interpretations seem dominated unduly by a personal working hypothesis, namely, the assumption of the exclusively entodermal origin of the earliest embryonic red blood cells and the occasional anomalous persistence of this entodermal blood primordium in postnatal life

The book includes 249 pages of text, subdivided into 14 chapters Chapter I gives an account of the reticulo endothelial system In Chapter II the blood forming function of this system is discussed Chapter III on "Leukaemia," and Chapter IV on pernicious anaemia, constitute in our opinion the most interesting portions of the book Chapters V and VI deal with leukaemoid blood pictures and reactions, Chapter VII with reticulo-endotheliosis, Chapter XI with Gaucher's disease and Chapter XII with Banti's disease There is an important appendix of 11 pages on hematological technique and a selected bibliography of 73 titles, with author's comments In addition the book contains four plates of very excellent colored illustrations, 23 in number, and 18 text figures

As regards the colored illustrations the reviewer, while admitting their artistic beauty and detailed accuracy, feels compelled to point out certain disconcerting omissions and seemingly forced interpretations. In the first place, one feels greatly handicapped in estimating the value of these illustrations as supporting the text by reason of the lack of any designation of either absolute or relative magnification This is all the more serious in view of the great significance ascribed by Piney to his so-called megaloblast In the next place one is not convinced on the basis of the illustrations that the so-called promonocyte is more closely related to the myeloblast

than to the lymphoblast. Then, too, the lack of illustrations of transition stages between the large lymphoblast and the small lymphocyte, and especially the absence of any illustrations of a large lymphocyte, seems unfortunate Furthermore, the eleven figures grouped under the name "megaloblast" are so very different in nuclear configuration and cytoplasmic staining reaction, that they can not with any propriety or accuracy be designated by a common term If the relatively larger size of these pro-erythroblasts is to be emphasized, surely Figures 9 and 10 are more properly called macro-normoblasts, a term improperly applied to Figures 12 and 14 These illustrations by no means support the claim that the alleged entodermal pro-erythroblasts differ specifically from the mesodermal pro-erythroblasts by the absence of a "cart-wheel" arrangement of the nuclear chromatin (Compare Figures 7 and 15)

In Chapter III, Piney stresses the importance of regarding leucemias as diseases of the hemopoietic tissues, rather than as "blood diseases." He accepts Orth's suggestion to designate all conditions of hemopoietic excess, usually accompanied by alterations in the circulating blood, as *haemoblastosis*, in essence a neoplastic condition Such hyperplasias may be restricted to the leucocytopoietic tissues or to the erythrocytopoietic tissues The former condition may be designated *leucosis* ("leukemia"), the latter *erythrosis* When the leucosis affects only the myeloid tissue, the condition becomes a *myelosis*, restricted to the lymphoid tissue, it constitutes a *lymphadenosis*. Either condition may be acute or chronic, leucemic or aleucemic The excessive number of red corpuscles in the circulation in the condition of erythrosis is termed *erythraemia* (polycythemia) A concomitant hyperplasia of both the erythrocytopoietic and leucocytopoietic tissue, Piney terms *erythro-leucosis*, or synonymously as *panmyelosis* Hyperplasias of the ancestral reticulo-endothelium may also occur as variations of hemoblastosis Such conditions are designated *reticulo-endotheliosis*, the leucemic variety possibly constituting monocytic leucemia, the aleucemic possibly Hodgkin's disease

The central and guiding concept in Piney's interpretation of hemoblastosis relates to the so-called "megaloblasts." In current hematological literature the term "megaloblast" is definitely restricted to designate the earliest transition stage between the ancestral hemoblast and the hemoglobiniferous normoblast. This cell is characterized specifically by the presence of a minute amount of hemoglobin in its otherwise basophilic cytoplasm, imposing a slight acidophilic staining reaction in polychrome stains, *e.g.*, Giemsa. In addition, it has a slightly larger size than the later generations of red cells (normoblasts and erythroblasts) and its nucleus generally lacks the nucleoli of the hemoblasts, and the basichromatin approaches the relatively coarse reticular condition of the normoblast Piney, quite arbitrarily it would seem, applies the term "megaloblast" to a large cell of the hemoglobiniferous series whatever its stage of development He uses the term in its strict etymological sense to denote a large maturing red cell, ancestor of an anucleate "megalocyte." Very much more important, however, is his conception of the *origin* of the "megaloblast", he derives it exclusively from the *entoderm* The megaloblast of Piney is therefore an entodermal element, and occurs normally only in the embryo. He says, "The embryo is thus supplied, for a short time, with two varieties of blood, one derived from the entoderm, and composed purely of hemoglobiniferous cells, and the other of mesenchymal origin, and consisting of both red and white cells"(p 19) This supplies the basis for Piney's interpretation of various leucoses in which megaloblasts appear in the blood It constitutes his chief contribution to the question of the etiology of pernicious anemia The appearance of megaloblasts in postnatal life he regards as always indicative of the persistence of some remnant of entodermal blood primordium He assumes further, that if this hemic primordium atrophies only incompletely in post-embryonic life, there occurs a concomitant defective development of the mesodermal myeloid tissues Pernicious anemia is interpreted as a condition in which, following a hereditary defect inherent in a hepatic persistence of entodermal hemocytopoietic tissue, there occurs correlatively a poor quality of bone marrow Naegeli had already pointed out that the presence of megaloblasts (mesenchymal ancestors of hemoglobiniferous megalocytes) in the blood is pathognomonic of pernicious anemia But Piney interprets this datum in a unique sense, he ascribes to these cells the significance of specific entodermal derivatives

Investigations on the origin of the initial red blood cells in the yolk sac of mammals and other vertebrates during the past twenty years give no support to the idea of an entodermal origin of these cells. From beginning to end, blood arises only from mesenchyme, the reticulo-endothelial system of various myeloid and lymphoid organs An alleged exception is described in the papers by Havet[1] and Aron,[2] who claim that

[1] Havet, J, 1926. L'origine des cellules du sang *Jour Anat* Vol. 60, pp 231–258

[2] Aron, M Quelques observations novelles a' propos de l'origine du sang dans le foie embryonnaire des mammiferes Arch. d'anat. d'Hist. et d'Embryol T 4, pp. 1–26.

in young mammalian embryos (rabbit, sheep, pig, guinea pig, and human) erythrocytes develop directly from hepatic parenchymal cells. These recently recorded results, however, lack confirmation, and the supporting illustrations admit of an alternative interpretation.

It is well known that in pernicious anemia generally the red corpuscles are of larger average size, thus determining a color index above unity, and that megaloblasts (initial stages in red cell formation) occur; but the relatively larger size of both may be quite as well, and much more likely, the result of an absence of normal proliferative activity of these pro-erythroblasts, as of persistent entodermal ancestors. The familial incidence of pernicious anemia may equally plausibly be explainable on the basis of a hereditary susceptibility to factors that affect the bone marrow, and other possible erythrocytopoietic foci, in such a way as to produce a condition characterized by relatively low proliferative activity among the ancestral cells, resulting in the appearance of many relatively large red cells, both mature and immature.

Another interpretative conclusion, in conflict with practically all recent work, relates to the restricted ancestry of the monocytes According to Piney, monocytes are derived from the reticulo-endothelial system exclusively through the myeloblasts, a monocyte being "as much a myeloid cell as is any other granular leukocyte"

Though emphasizing the alleged distinctive character and apparent independence of the lymphatic and myeloid tissues in many respects, Piney is forced to admit certain obvious interrelationships as indicated in certain infections where lymphocytosis coexists with a neutrophilia, following a leucopenia during the height of the infective process A probable explanation seems to be at hand in the repeated demonstrations that lymphocytes may develop into granulocytes At the height of the demand for neutrophils the lymphocytes may be very rapidly converted, effecting a resulting lymphocytopenia, which may be later overcorrected through an attempt at compensatory readjustment of normal numerical relationships Similarly the anemia almost invariably accompanying leucemia might be interpreted in terms of the limited availability of the common ancestor (the lymphoid hemoblast) for erythrocytes, granulocytes and monocytes. When the specific stimuli are such as to demand an excess of one of the derivatives, the other possible differentiation products may be reciprocally, at least temporarily, reduced in numerical proportion. This differs from Piney's explanation that since (as he claims) erythrocytes arise only intravascularly, and leucocytes extravascularly, specific morbid stimuli may reach one surface of the common blood cell primordium without affecting the opposite surface.

H E JORDAN

UNIVERSITY OF VIRGINIA

DOES THE AMOUNT OF FOOD CONSUMED INFLUENCE THE GROWTH OF AN ANIMAL?

THE question to which this discussion is addressed might well be considered an impertinent one to raise in a scientific journal were it not for the fact that a number of research laboratories in this and other countries appear to be attacking many important problems in nutrition by methods involving the tacit assumption that *the composition of the diet alone* determines the changes in body weight secured in experimental animals When stated in such plain terms as these, the situation, if it actually exists, would appear to be sufficiently serious to justify general consideration and discussion, to the purpose that the time and energy being devoted to nutritional problems should yield the greatest return in unequivocal experimental evidence.

Obviously, the point of first importance is to determine whether the situation characterized above actually exists This characterization may be illustrated in an abstract way as follows. It is desired to determine whether a given food material is deficient in a certain dietary essential A. Accordingly, two rations are made up, including the food material in question supplemental with adequate percentages of all known dietary essentials except A In one ration, A is included in place of an equal percentage of a dietary diluent such as starch, while in the other ration the food itself serves as the sole source of A Now, it is the general plan to feed ration No 1 to one group of animals, and ration No 2 to another, the food in each case being offered *ad libitum* The changes in weight of the animals are then followed by periodical weighings. In some cases, records of food consumed may be kept and, in fewer cases, such records may be reported, but in the great preponderance of cases, no *control* of food intake is imposed, and the weight curves are interpreted with reference only to the composition of the rations.

Is not this type of interpretation tantamount to assuming that the amount of food consumed has no influence on growth? The assumption itself is obviously untenable, and the interpretation can be defended only on the very tenuous supposition that the

more adequate of two rations will *always* be consumed in the larger amount and that, therefore, a greater consumption of one of the two comparable rations is, itself, *prima facie* evidence of its nutritive superiority over the other. While it is true that there is a marked tendency, frequently referred to in the literature, for experimental animals to eat sparingly of markedly deficient diets,[1] to assume that this is the only factor of importance operating in the determination of the daily consumption of food is to deny the influence of flavor, odor, and texture of the diet, and to endow the appetite of the animal with an infallibility impossible to explain on physiological grounds or to believe on empirical grounds

Returning to the hypothetical illustration, if ration No 1 has induced better growth than ration No. 2, there are two possible explanations, either (a) it is actually superior in its nutritive balance, so that if consumed in amounts no greater than ration No 1, it would still induce better growth, or (b) it has been consumed in so much larger amounts than ration No. 2 that better growth has resulted from this fact alone, with no reference to the difference in composition Current practice neglects the latter possibility entirely, apparently because no obvious reason exists for supposing that ration No. 1 is more palatable than ration No 2, hence, if it has been consumed in larger amounts it must be because it is more nearly adequate in nutritive value. But this is devious reasoning It is true in many cases it may lead to a highly probable conclusion, nevertheless, in no case can an interpretation based upon such reasoning be awarded the finality of a demonstration Surely it is the purpose of experimentation to demonstrate *something* whenever possible, rather than to set up a certain probability of its truth, and in this type of work a demonstration can be secured only by controlling the food consumption of the experimental animals in such a way that the intake of food by comparable groups is the same, either absolutely or in proportion to their requirements.

The many different problems in which this question of experimental technic is involved can only be appreciated by specific illustrations The significance of food intakes is involved in every step of the method for the "biological analysis" of foods introduced into rather general use about twelve years ago, and the neglect of dietary control with reference to the amount of food consumed is a proper obstacle to the acceptance *in toto* of the deductions regarding the dietary deficiencies of the large number of foods investigated. The method has contributed valuable viewpoints to the science of nutrition and has undoubtedly furnished an essentially accurate bird's-eye view of the situation with reference to relative food values. Nevertheless, the details of the results with reference to any particular food can not be considered as established facts until confirmed by more refined methods As a pioneer method, it has served its purpose well, but pioneer methods are of use only in pointing the way to profitable investigation by providing working hypotheses, it is unfortunately true that several laboratories are still using the method in a routine way in attacking specific problems

A recent contribution from an agricultural experiment station, involving several years' work upon a large number of animals and rations, attempts a scientific analysis of the factors concerned in the production of rickets (posterior paralysis) in swine with no reference at all to the food records secured, though these records were extremely variable among the lots of animals compared If the efficiency of a number of rations in promoting growth or protecting against disease varies in close correlation with the amounts of them consumed by the experimental animals, it is but natural to suppose that the biological reactions observed may have been determined entirely by the intake of food regardless of its composition If one of two comparable rations has induced a more rapid growth than the other, as well as a greater consumption of food, there must always be a doubt as to the growth that would have resulted from the other ration if it had been consumed in as large amounts as the first

Fortunately, the ambiguity inherent in the experimental results obtained from the "biological analysis" of a food by means of *ad libitum* feeding experiments is becoming increasingly evident to investigators in nutrition The prevailing tendency in determining the nutritive value of a food material is to consider each individual nutrient as presenting a problem in itself, to be investigated by a method found to be most effective for that particular nutrient As a result, there are available at the present time reasonably accurate methods for the determination of the protein values of foods and of the relative concentrations of foods in vitamins These methods differ essentially among themselves in the experimental conditions imposed, the kinds of animals used, and their preliminary preparation. In the most accurate methods for the quantitative study of the distribution of vitamins, the necessity of securing definite intakes of the food material under investigation is fully recognized, although the intake of the basal ration used in providing a suffi-

[1] The conclusion has also been drawn that rats eat in accordance with their energy requirements rather than in accordance with the balance of nutrients in the ration. Furthermore, many instances have been reported in the literature in which inadequate diets are consumed for a considerable time in adequate amounts, and vice versa.

cient source of energy and in supplementing the food in all essential dietary factors except the one under investigation, is not controlled It may be questioned whether control of the intake of basal ration is not also advisable, since it will undoubtedly vary with different animals, and will be inversely correlated with the intake of the food material being studied For the same intake of the food under examination, a variable intake of basal ration presumably would affect the rate of growth secured

Much work has been done upon the existence of vitamins specifically concerned with reproduction and with lactation Feeding experiments with uncontrolled food consumption have been used throughout this work, and several of the conclusions drawn from such experiments seem unwarranted because of the failure to realize that the biological performance of an animal may be distinctly different on different intakes of food, particularly if the rations fed are not absolutely deficient in any essential food factor. The confusion prevailing in this field at the present time and the slow progress being made may be considered as an inevitable result of improperly controlled experimental procedures

The question of the significance of arginine and histidine in nutrition has occupied the attention of a number of investigators, in this country and in England, during the last ten years While it is the consensus of opinion that the indispensability of histidine is well established, the evidence is conflicting with reference to arginine Again the trouble appears to be related to the methods of experimentation, *i e*, feeding experiments on rats in which the food intake is uncontrolled One laboratory reports that the addition of either arginine or histidine to an amino acid mixture deficient in both renders it capable of supporting growth, a result indicating an interchangeability of these two amino acids in metabolism Another laboratory has reported success in this experiment with histidine only, repeated attempts to supplement with arginine resulting invariably in failure to secure growth, though long-continued maintenance of weight was occasionally observed This laboratory most emphatically denies the interchangeability of arginine and histidine on the basis of its negative results Other laboratories have reported favorable effects of arginine additions to amino acid mixtures deficient in both arginine and histidine, though only maintenance of weight rather than growth resulted In those experiments in which food intakes are reported, it is a significant observation that where failure of growth and of maintenance resulted on the arginine rations, the food intakes were so low that it is a fair suspicion that they were inadequate for the maintenance of weight. In fact, the results of this series of experiments suggest that success in obtaining growth on the arginine rations was in proportion to the success in inducing the animals to consume them.

It is perhaps a sound criterion that a ration can not be adjudged incomplete or inadequately balanced, until nutritional failure results *when it is consumed in adequate amounts*, or unless it induces distinctly less favorable results in experimental animals than a ration known to be complete, *when they are consumed in equal amounts*[2] Under the circumstances, therefore, more significance would appear to attach to the favorable results obtained by arginine additions than to the unfavorable results It is undoubtedly desirable that the interchangeability of arginine and histidine in metabolism be confirmed if possible, preferably by some other method more amenable to interpretation, nevertheless, it is a fair conclusion that the negative results reported do not disprove the possibility of an interchangeable relation

A natural extension of such inadequately controlled feeding experiments to the solution of problems of intermediary metabolism has been in evidence during the last few years The question whether taurine can replace cystine in metabolism has been studied in four laboratories by feeding experiments with small animals In one laboratory the results obtained were taken to indicate the possibility of such a substitution, in two laboratories the non-committal conclusion was drawn that no evidence of such a possibility was obtained, while in one laboratory the negative evidence secured was the basis of the conclusion that taurine is "totally incapable" of replacing cystine in the diet for purposes of growth However, the lack of control of food consumption in all these experiments in assuring comparable food intakes among otherwise comparable groups, renders a definite interpretation of them difficult, if not impossible

Similarly, the results of experiments involving rations containing, in place of histidine, imidazole derivatives and other compounds with which it might be related biochemically, have been interpreted with reference to the possibility or otherwise of certain metabolic reactions involving this amino acid. No criticism can be made of the most obvious interpretation of such experiments when continued growth is observed; but when failure of growth results, interpretation seems impossible, although it is commonly supposed to demonstrate that the ration used is inadequate This, however, appears to represent an

[2] As proof that this is not an impossible or impracticable requirement, the demonstration that non-leucine can not replace lysine in metabolism may be cited (Lewis and Root, J Biol. Chem, 1920, xliii, 79).

exaggeration of the importance of negative experimental results

Negative experimental results may have two meanings: (1) They may demonstrate definitely that something is not true, and, if this outcome is quite unexpected in view of contemporaneous theories and conceptions, the results may be of great significance. On the other hand, (2) they may represent simply unsuccessful attempts to demonstrate something, due to the use of inadequate experimental methods or to the selection of unsuitable experimental conditions, in which case they are of no considerable importance. It would appear that the type of negative experimental result obtained with inadequately controlled feeding experiments should be classified under (2), since it has not been definitely proven by proper control experiments that the failure of growth or maintenance can *only* be due to the inadequate composition of the ration.

As illustrating the ultimate result of a line of reasoning that is so frequently implied and pursued in the interpretation of incompletely controlled feeding experiments, another recent investigation concerned with histidine synthesis in the animal body may be cited. In this study evidence was obtained of the successful substitution of histidine by imidazole lactic acid and also by imidazole pyruvic acid, and a distinctly favorable effect on body weight of the addition of imidazole acrylic acid to histidine-poor rations was also observed. From the rates of growth secured on the different rations, conclusions are deduced concerning the intermediary metabolites of histidine, the reversibility of the reactions involved, and even the relative speeds of such reactions. These interpretations fail to consider the great differences observed in the consumption of the different experimental rations, which have been averaged and summarized in the following table.

No. of periods averaged	Rations	Aver. body weight of rats gms.	Aver. daily food intake gms.	Aver. daily gain in weight gms.
17	Basal, no histidine	99	2.3	−0.86
6	Basal, plus histidine	107	7.2	+1.67
4	Basal plus imid. lactic acid	98	5.9	+1.36
4	Basal plus imid. pyruvic acid	81	3.8	+0.45
6	Basal, plus imid. acrylic acid	112	3.2	−0.10
8	Basal plus imidazole	102	3.4	−0.25

It is evident that the changes in weight, although obtained in prompt response to the changes in ration, are closely correlated with the amounts of food consumed, and hence, in the absence of any evidence to the contrary, may be the direct result of the variable food intake. The experiments can not be said to demonstrate that the basal ration was inadequate, since the daily consumption of 2.3 gms. of food, no matter how well-balanced it may be, could not maintain the weight of a 100 gm. rat. The responses to the various additions to the basal diet may indicate: either (1) that the basal ration is in fact adequate and is capable of supporting growth when consumed in adequate amounts, or (2) that the basal ration is inadequate but that all of the imidazole derivatives added to it are equally effective substitutes for histidine, the variable growth secured depending primarily upon the amount of food consumed; or, finally (3) that the basal ration is inadequate and that the various additions to it are effective in replacing histidine in metabolism in proportion to the amount of growth secured, the variable food intakes being a purely incidental manifestation of the infallibility of the animal appetite in consuming food in proportion to its completeness in meeting the body's requirements. The authors of this report subscribe to the third interpretation, without, however, considering or refuting the other two.

These illustrations of published investigations involving feeding experiments on animals may be taken as proving that biological investigations are frequently based upon the implicit assumption that the amount of food an animal consumes has no effect upon growth and hence is not a legitimate part of the experimental evidence and, therefore, may be disregarded in the interpretation of results, or upon the equally erroneous assumption that the amount of food an animal consumes is determined solely by its value in nutrition. An experimental animal is considered as a sort of biological reagent of marvelous accuracy and varied uses, capable of giving as significant a response in body weight change to a change in ration, as the color response of a chemical indicator to a change in hydrogen ion concentration around the point of neutrality. Unfortunately this conception of the infallibility of experimental animals can not go unchallenged, and the methods of experimentation blindly involving this conception are in need of revision. They can not be considered to be properly controlled except when the rations whose nutritive effect it is desired to compare are fed in equal amounts to comparable animals. Even when the amounts thus fed are inadequate, due to the refusal of the experimental animals to consume readily one or both of the rations, it is reasonable to expect that the inferior ration will ultimately induce a greater decline in

weight than the other, or that it will lead to total nutritive collapse sooner. Admittedly experimentation under these conditions is not wholly satisfactory, but investigators should reconcile themselves to the fact that it is difficult to demonstrate the inadequacy of a given ration in any essential dietary factor when the experimental animal will not readily partake of it. Probably in many situations of this character the use of growth experiments is contraindicated. The success of any biological investigation is undoubtedly endangered when the experimental animal will not cooperate to a certain minimum extent

H. H. MITCHELL

COLLEGE OF AGRICULTURE,
UNIVERSITY OF ILLINOIS

SPECIAL ARTICLES

OVARIAN SECRETION AND TUMOR INCIDENCE

FOR several years an attempt has been made to build up, by selective inbreeding, lines of mice which should have a very high incidence of mammary cancer. This effort has been quite successful, and it has been possible to establish two lines in an inbred dilute brown stock,[1] which produce very nearly 100 per cent cancerous females. Among 183 breeding females of this dilute brown stock, taken in linear order from our ledger, 122 were tumorous. Of the remaining sixty-one, many died before reaching tumor age

Under normal breeding conditions the neoplasms appear in the vicinity of the mammae of the females between the ages of four and fourteen months The tumors usually appear, however, between the beginning of the seventh and the end of the eleventh months, the mode being at nine months.

It has been known for some time that the internal secretions of the ovaries play an important part in the physiological condition of females during and after the gestation period That the influence of these hormones has also a direct effect upon the ability of mice to combat the growth of neoplasms has been demonstrated by Dr. L. C Strong[2] (1922) in his work upon transplanted tumors Dr Leo Loeb[3] has also published (1915) a brief note on the effects of castration and enforced non-breeding on tumor incidences. More recently (1927) Dr Carl F. Cori[4] has published a very interesting paper on the results of castration and ovarian transplantation in mice.

[1] This stock has been developed from a single pair by Dr C C Little, and has been inbred, for the most part, by brother to sister matings since 1909

[2] Strong, L C, *Jour Expt Zool.*, 36 1, 1922

[3] Loeb, L., SCIENCE, Vol. XLII, No. 1095, Dec. 24, 1915

[4] Cori, Carl F., *Jour. Expt. Med.*, Vol. XIV, No 6, June 1, 1927, pp 983–991.

I. What is the effect of enforced non-breeding upon cancer incidence in female mice?

That either or both of two factors: (a) the stimulating effect of lactation and pregnancy, and (b) the effect of sex hormones, may be involved in the appearance of cancer in the stock under observation, is demonstrated by the fact that when 207 virgin females of the dilute brown stock were separated from the males before sexual maturity and allowed to grow old under exactly the same conditions as the stock mice, which in many cases were siblings of the virgin females, but twenty tumors have appeared among them, although the youngest of these animals is fifteen and a half months old The earliest age at which cancer appeared was ten months, the average 14.7 months, and the oldest seventeen months, as contrasted with four months, nine months and fourteen months for the breeding females (see Table I, lines 1 and 2)

TABLE I

AGE IN MONTHS

	Youngest	Average	Oldest
Breeding females	4	9	14
Non breeding females	10	14 7	17
Castrated females	9	15 6	18 8
Castrated males with ovarian implants	8	11	13

From this we may infer that enforced non-breeding delays very markedly the age of tumor appearance and may even inhibit entirely the development of cancer in mice, which would probably have had a high incidence of tumor appearance had they lived a normal sexual life.

II. Will the female mouse grow a tumor when completely castrated?

The ages at which tumors occur in the normal breeding females indicate that the appearance of the neoplasms is closely correlated with the normal[5] activity of the ovary and ovarian hormones. One possibility is that cessation of ovarian action following a period of activity is the chief stimulating factor in producing mammary cancer. If, then, females in which the ovary has functioned at a low rate for a time are completely castrated, it might be expected that these animals will develop tumors at an age which is actually *younger* than that at which normal breeding females develop cancer. With this in mind, 210 females were spayed and allowed to grow old under the same laboratory conditions as the stock animals. To date twenty-one of these females have developed

[5] Normal activity of the ovary is here taken to mean that of a breeding female rather than a non-breeding animal.

tumors. However, the ages at which these animals develop neoplasms is strikingly higher than that at which the normal breeding animals develop cancer. (See Table I.)

It appears from these figures that the absence of hormone activity has a retarding effect on neoplasmic development, and may even inhibit tumorous growths, since practically all of the normal breeding females develop tumors if they live to 14 9 months of age, while in the castrated females only twenty in 210 have developed tumor, although they have all reached an age equal or greater than that at which the oldest breeding female developed neoplasms

The complete absence of ovarian secretion has much the same effect on cancer incidence as does forced non-breeding

It appears from this that the secretions of the ovaries under ordinary non-breeding conditions are not primarily the ones which stimulate tumor, but rather that it is commonly those conditions of hormone secretion in anticipation of the feeding of the embryo and young

III Do testicular hormones inhibit the growth of mammary tumors?

Since mammary cancer does not occur among the males of this race of mice, we might expect that possibly the testicular hormones inhibit these neoplasmic growths If this is the case, the removal of the testes would remove the inhibitor and the operated individuals would be likely to develop tumor. In order to test this theory, 241 males of this race of mice were castrated at about four weeks of age and allowed to grow old under the same laboratory conditions as the stock animals

The youngest of these animals lived to be fifteen months old and the oldest twenty-two months of age without developing a single tumor The relief from inhibition caused by castration at four to five weeks of age is, therefore, not sufficient to allow the growth of mammary tumor There is a possibility that the testes of these mice had begun to secrete in sufficient amounts to protect these mice against tumor after castration. Possibly, had they been castrated at an earlier age, different results might have been obtained This, however, is very doubtful.

IV. Is it possible to grow mammary tumors in castrated males by transplanting ovarian tissue?

If it is the ovarian hormones which are causing the growth of tumors, ovarian tissue transplanted to castrated males encourages tumor development. With this in mind, 210 males were castrated and a whole ovary implanted subcutaneously in the abdominal region. The animals were then allowed to grow old. At the time of writing, when the youngest of these animals is ten months of age, *four have developed mammary tumors*—a thing never seen in the thousands of normal male mice of this inbred stock.

It would seem that the ages of cancer appearance in these animals should approach the curve of the virgin females, although the numbers are very small.

Discussion

These results are interesting in that they correspond very closely with those reported by Dr Carl F Cori (1927) Our data, however, differ in several ways from his. Whereas he castrated his females at 15–22 days of age, we castrated ours at 28–35 days of age. Tumor was completely inhibited in his mice, while it was only partially inhibited in ours This somewhat supports his conclusion that spontaneous cancer in the mouse is due to the lack of ovarian hormones after having had the use of it for a time

Dr Cori reports that in his castrated males, to which he transplanted two whole ovaries, no tumors appeared Our experiment differed from his in that we transplanted but one ovary and obtained four males with mammary tumor from 210 animals treated in this manner It is of interest to note that pathological diagnosis shows these tumors to be of the same type as those developed by the females in this strain of mice, namely, adenocarcinoma.

It is well known that in order to make successful transplantations of tissue, the animals involved must be very closely related Possibly Dr. Cori's failure to feminize males was due to the fact that his stock was not sufficiently inbred, and the ovarian implant therefore degenerated.

Conclusions

(1) Non-breeding reduces tumor incidence in mice and delays the time of tumor appearance (207 mice used).

(2) Two hundred and ten female mice castrated at 28–35 days behave much the same as non-breeding females.

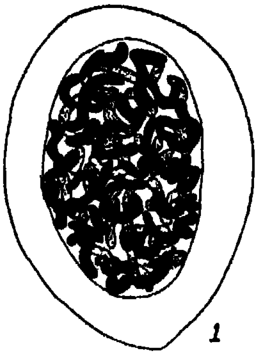
(3) Two hundred and forty-one males castrated at 28–35 days did not develop tumor, thus resembling non-castrated males

(4) Spontaneous tumors, never obtained in thousands of normal males of the stock used, may develop in castrated males which have received subcutaneous transplants of ovarian tissue (210 operated—four tumors).

William S Murray
Laboratory of Mammal Genetics,
University of Michigan

THE CHROMOSOMES OF THE RAT

An attempt to use the chromosomes of the rat as confirmatory evidence in certain phases of work on



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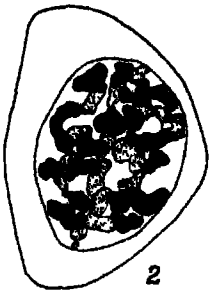

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human chromosomes brought out the fact that our mixed strain of laboratory rats shows an unusual situation in chromosomal behavior The number of chromosomes of the albino rat as determined from three independent colonies of the Wistar strain is 42[1] An examination of 38 rats from our colony shows that 21 of those possessed 42 and 17 had 62 chromosomes The latter group is shown in Figures 1 to 3, Figure 1 being a prophase somatic group of 62 chromosomes from the nucleus of a mesenchyme cell in the testis of an embryo rat of 20 days, Figure 2 gives a tetrad group of 31 chromosomes from a primary spermatocyte from the testis of an adult rat, and Figure 3 a prophase somatic group of 62 chromosomes from a mesenchyme cell from the ovary of an embryo rat of 20 days Thus two kinds of chromosome patterns occur in the same colony

Since these rats had been mated indiscriminately, the natural expectation would be that the rats resulting from such unions would show 52 chromosomes Rats with 52 chromosomes could not be found. Continued study of rat testes from the individuals of our colony, regardless of whether the diploid count was 42 or 62, showed that two kinds of secondary spermatocytes or spermatids are always present, one kind containing 21 chromosomes and the other 31. No variation in the number of chromosomes present in the spermatogonia or the first spermatocytes was found in any case. The changes producing a spermatid with 31 chromosomes in the 42 group or one with 21 chromosomes in the 62 group occur in the interkinetic period or early prophase of the second spermatocytic division

The absence of rats with 52 chromosomes led to the conclusion that a sperm with 21 and an ovum with 31 chromosomes for some reason could not mate, like mating only with like Confirmation of this was found in mating a strain of white rats obtained from Professor Slonaker, of Stanford University, which was found to possess only the normal number of 42 diploid and 21 haploid chromosomes, with individuals from the colony Four such matings were made and the resulting 24 embryos fixed on the 16th day. All of these embryos had 42 chromosomes. Matings made at the same time among the individuals of the colony gave litters, some members of which had 42 and some 62 chromosomes

Our rat colony has come from a cross made in Berkeley by Professor J A. Long about 1912 between an albino (*Rattus rattus norvegicus albinus*) from the Wistar Institute mated with the common wild gray rat (*R rattus norvegicus*), or what was considered this species at the time. Slides of the testes of the original strain of pure albino rats show 42 as the diploid and 21 as the haploid number of chromosomes. Unfortunately, no tissue is available from the original gray animal used as one of the parents of the hybrid stock

It is interesting that two wild gray rats (*R. rattus norvegicus*) obtained by trapping in one of the warehouses in Oakland each gave a chromosome count of 42 The number of chromosomes in the spermatids of these has not yet been determined

The following interesting facts, repeatedly confirmed, have emerged from these studies.

1. The albinous norway possesses 42 diploid chromosomes.

2. Two local wild gray norways were also found to possess 42 diploid chromosomes.

3. Our hybrid rat colony contains two types of members, those with 42 and those with 62 diploid chromosomes. Each produce two kinds of spermatids, one having 21 and the other 31 haploid chromosomes.

4. Matings are evidently possible only between sperm and ovum having a like chromosome number.

Olive Swezy

Anatomical Laboratory,
University of California

[1] Painter, T. S, 1926, Science, Vol. 64

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SOME APPLICATIONS OF PHYSICAL CHEMISTRY TO MEDICINE[1]

THE growth of knowledge, like most processes of growth, is autocatalytic It is self stimulating The discovery of fact, principle or idea speeds the discovery of new facts, principles and ideas Progress is thereby self accelerating, although the acceleration is not constant, but increases for a time after each discovery only to slow up or to come to a constant velocity until some new catalyst is discovered A remarkable feature of this growth of science, a feature which shows that knowledge is indeed an organic whole, is that an idea or fact discovered in one branch of science often serves as a catalyst to a very remote and apparently unrelated branch

Nowhere is this illustrated better than in the repercussions between physics, chemistry, biology and medicine The study of what is going on in an evacuated glass tube provided with electrodes, when there is a strong difference of potential between those electrodes, results in the discovery by a physicist, Crooks, of the so-called "cathode ray", study of this ray by another physicist, Rontgen, leads to the discovery of the X-rays set up when the cathode rays impinge on glass, metal or other solid surface, and as a result the physician is provided with a means of seeing the bones, the stomach, intestines, heart, ureters, and gall-bladder of a living man, of learning whether these are normal or not, and he is in addition provided with a means of treating successfully many hitherto hopeless conditions

But the effects of this discovery do not stop here, even more important to physiology and medicine is the resulting study of the mechanism by which the X-rays act upon the body For it is clear that if substances are opaque to X-rays, they must absorb such rays And when they absorb such rays the energy in the ray is passed to some substances in the tissues, or to substances which have been introduced into the cavities of the body to make their outlines visible Now molecules of substances which have absorbed energy are in a quite different condition from molecules of the same substance which have not. Energy is that which gives the power of acting. So substances which have absorbed energy are thereby rendered far more reactive than they were before.

[1] Lecture given at the University of Buffalo, April 12, 1927, on the Harrington Foundation.

Being thus reactive they become more toxic, or more curative. Or they may be destroyed.

Hence the study of the luminosity of gases in partially evacuated electrode tubes, besides causing a revolution in physical theory, ultimately resulted in providing a method for introducing energy into the interior of the tissues of the body, which energy is useful in destroying tissues which are overgrowing, such as cancers, or various glands, or in destroying parasites.

A tremendous and rapid development of diagnosis and therapeutics, a development still in progress, has thus resulted in medicine from a discovery made in a totally different field of science It is indeed as if in the body of knowledge an organ called physics secreted a hormone, which led to the intense development of another remote organ, called medicine. And it is almost certain that medicine or biology thus stimulated will ultimately react on physics to produce in its repercussion as great an effect on it When this repercussion comes it will probably revolutionize the physicist's conception of matter.

It is indeed true that all of the organs of the body of knowledge are thus metabolically and nervously coordinated and they act and react on each other leading either to an acceleration of development of old organs, or to their atrophy, just as in the body of a tadpole, the thyroid hormone enormously stimulates the development of the limb buds, while it produces atrophy of the tail and the gills, organs no longer useful in the changed conditions of the life of the progressive organism

Nowhere is this interdependence of the sciences better illustrated than in the interrelation of medicine and physical chemistry, and no better example can be found than here of the saying that a scientific man never knows what he is doing For he, no more than others, can look into the future to see what the consequences of his work will be The results are always concealed from him All that he can see is the effect of ideas after they are past. He is blind, for no one can see even sixty seconds into the future. The past is illuminated by the light of memory, the future is wrapped in the impenetrable darkness of fate, or lighted only by the deceptive and ghost-like glimmer of the law of probability.

Physical chemistry itself was in a large measure a result of a discovery by botanists Plants, as you know, are among the most interesting of animals. They differ from other animals in that they are sessile —they do not move from place to place, and they possess chlorophyll, a wonderful apparatus for catching and utilizing the ethereal vibrations of light. From this captured light they derive their own vitality; and they imprison part of it, which they do not need themselves, in oxygen which turned loose in the air constitutes a great reservoir of vitality from which we and all animals get our life. Now plants have a circulation not so unlike the circulation of the blood of animals. It is a circulation of sap; a sap containing food—mineral and organic—which streams up to the leaves and buds and growing parts and nourishes them The pressure of this sap was first measured by Stephen Hales, who also measured the pressure of blood, two centuries ago

It has always been a puzzle to botanists how the movement of this sap is produced, and many of the great botanists have worked upon this problem. Among them were Dutrochet in France, and many years later De Vries in Holland and Pfeffer in Germany. These earlier workers had the idea that the rise of the sap might be due to a process which was similar to that which occurred when a pig's bladder full of sugar solution was placed in water Water then entered the bladder and a very high pressure was thus generated leading to the distention of the bladder This process was called osmosis. The passage in of the water was called endosmosis, that of the sugar out, exosmosis It might be that in the roots, water was thus imbibed and the sap expanded in volume was forced upward and into all the twigs of the plant Modern work makes it doubtful whether this is the mechanism, but one begins with a simple theory To make this a scientific theory it was necessary to measure the pressure of sap on the one hand and the pressure which solutions of substances in water were capable of exerting when they expanded, on the other It was necessary to see whether such an osmotic pressure could account for the rise of the sap.

The botanists De Vries and Pfeffer measured the osmotic pressures of salt and sugar solutions, and largely because of these measurements a new science was born, the science of physical chemistry The botanists did not know they were creating this new science They themselves did not solve the problem of the movement of sap. That is a vital problem and according to Professor Bose's recent work, involves the vital pumping activity of certain cells of the plant, analogous in their rhythmicity to the beating of an animal's heart. But while De Vries and Pfeffer did not solve their problem, out of their work two fundamental concepts came; the first was contributed by the great Dutch chemist, van't Hoff. From the observations of Pfeffer he showed that the osmotic pressure measured by the botanist was exactly that pressure which a number of molecules of hydrogen gas equal to the number of sugar molecules in the sugar solution would exert if the molecules of gas were confined in a volume as large as that of the

solution; and furthermore the variation of the osmotic pressure with temperature was the same as that of hydrogen gas with temperature.

This idea of van't Hoff when united with the facts of Pfeffer made a catalyst which stimulated a great volume of work throwing light on the nature of solutions; and it caused that development of physical chemistry, of the application of the methods of physics to the study of chemistry, which resulted in the splendid growth of knowledge in this branch of science which occurred from 1880–1920

The other great contribution, developing from the facts discovered by these botanists, was that made by Arrhenius De Vries found that most salt solutions had a higher osmotic pressure than van't Hoff's law of correspondence between osmotic and gas pressure indicated The Swedish physical chemist, Arrhenius, pointed out that this was probably due to the dissociation of molecules of salt into two or more fragments, a dissociation analogous to that which occurred in some gases, such as nitrogen pentoxide, and that the extra pressure observed was due to these dissociated parts of molecules Furthermore, he identified the dissociated parts with the ions described by Faraday and Clausius. These ions were electrically charged bodies which carried the current resulting when electrodes were put into a salt solution. This fruitful idea was established as a fact by experiment.

Thus was founded the theory of ionic dissociation which revolutionized chemistry, and of which the application to medicine have been extremely important.

Something further was required, however, to make these two simple and illuminative conceptions of value to medicine. This something was the discovery that such colloids as existed in living matter were electrically charged. This discovery was made by Sir William Hardy in Cambridge, England, about 1898 He found that the protein particles in solution when subjected to the action of electrodes—that is of the electric field—often migrated in the field, sometimes going in the direction of the current to one electrode, sometimes to the other, and sometimes not moving. Since all particles which migrate in an electric field must be electrically charged, this proves that protein colloidal particles were often electrically charged.

This discovery completed the fundamental work on the electrical state of the protoplasmic constituents. Protoplasm was seen to consist of colloids which often at least were electrically charged; and the salts present were also in the form of electrically charged particles.

It is impossible to give those who were not at the time engaged in studying these problems a conception of the wonderfully clarifying effect on biology and medicine of these few simple facts and theories. But a basis was at once given for the explanation of many until then wholly obscure things The speaker was so fortunate as to have a part in this great clarification. It provided a scientific basis for the many important contributions of electro therapeutics, including the recent development of diathermy, it gave an explanation, incomplete to be sure, of the electrical phenomena of living things and of electrical stimulation and depression The reason why the acidity or alkalinity of the tissues was so important for their normal function was seen to be a natural result of this dissociation, since any change in hydroxyl or hydrogen ion concentration at once changes the state of aggregation and the physiological activity of these proteins The discovery of the importance of hydrogen and hydroxyl ions led to the recognition of the diseased state of acidosis, of the importance of the maintenance of the neutrality of the tissues and organs And recently it has led also to the recognition of the evil results of deviation in the other direction toward alkalosis. The pathological states of acidosis and alkalosis appeared from this discovery first as a probability, and then by experimentation as established facts And the results of upsetting the acid-base equilibrium, or the balance of the salt solution, in the blood and tissues, could be forecast in theory and were established in practice

For the first time, also, we had an explanation of why mercury, silver, gold and copper salts should be so vastly more toxic than salts of sodium, potassium, magnesium, calcium and iron This followed from the discovery that the amount of energy liberated when the ions lost their charges was a measure of their toxicity. Sodium, in the metallic form, was so extremely toxic and caustic because it contained a vast store of energy which it liberated when it changed to the ionic form, and mercury and silver in the ionic or salt form were so toxic and caustic because they contained a large amount of energy which is liberated in changing toward the state of metallic mercury or silver or when united with any substance.

There was still another of its concepts which was destined to throw great light on physiological and pathological processes. This was the concept of oxidation developed by physical chemistry. It may be called, indeed, the electric theory of oxidation. It was the next step necessary to take if we were to be able to give an electrical description of life; for oxidation—that is respiration—is the means by which all living things get their energy.

Before the era of physical chemistry there was no good conception of oxidation other than the ordinary one of union with oxygen. This is of course the

original meaning of the word oxidation, which signifies literally *a souring*, for the reason that acids are produced when oxidation occurs of most although not of all materials The word oxygen itself means literally the "maker of acids" But there was no general explanation of the nature of all oxidations such as that of metals by acid, of the iodine in iodides by ferric salts and so on, where oxygen was not involved The physical chemist discovered what was really at the bottom of all oxidation whether they were due to oxygen or not In all cases of oxidation he found that there is an increase in the number of positive valences in the substance oxidized, or, what is equivalent to this, a decrease in the negative valences And, finally, when the electrical and electronic nature of valence was finally understood a few years ago, it was seen that in every case of oxidation, the oxidized substance lost a negative electron, and thus gained a positive charge In other words, in every oxidation there is always a flow of electricity—of positive electricity—since the current is always supposed to be in the direction of movement of the positive, from the oxidizing to the oxidized body Oxidation, then, was seen to be in reality also an electrical affair, and every electrical current to be endowed with the potentialities of oxidizing The great value of this conception of physical chemistry to medicine consisted in that it gave for the first time a rational explanation of the electrical currents which are found everywhere in the body. As every physician knows, whenever the heart beats there is an electrical disturbance which is propagated from the heart throughout the body By leading off from the hands or from one of them and the feet, or from tongue to foot, or in other ways, these currents may be made to traverse circuits outside the body, and are then readily perceived and registered by a galvanometer These extra corporeal currents have now become a valuable means of investigating the physiology of the heart beat and of aid in diagnosis of heart disease of various kinds. The exact way in which these currents are generated in the heart is still not certainly known, but enough is known to permit the statement that they are correlated with the process of oxidation which occurs in the heart muscle and which supplies the energy for its muscular contraction.

Moreover, it is now becoming clear that these currents, thus traversing the body, are in some cases at least of very great importance to it Many years ago the speaker discovered that the well-known polarity which all organisms show, both plant and animal, was at least in some instances accompanied by, if it was not the expression of, an electrical polarity. By organic polarity I mean the difference between the root and the apical end of willow and other stems; the tendency of the apical bud to hold back the development of buds below it; the tendency of the piece of a hydroid, a sessile animal, to form a polyp at one end and stolons or roots at the other. I found that that part of the animal which would most rapidly regenerate a part cut off was always electrically negative (to the current outside the body) to the part which regenerated more slowly, and I suggested that these differences of electrical potential between different parts of an organism, small though they were, might be of very great value particularly in the differentiation of organs and tissues in the course of embryonic development

This suggestion has now been put on a very much firmer basis by the discovery by Child that there is a gradient of metabolism, which is accompanied by a gradient of an electrical kind, in all developing organisms, the nervous system, or its fundament, is the point of maximum growth and chemical change, and this point is electro-negative to the rest of the body, and that this gradient in some way or other controls development along the axis It is an important factor in inheritance and in the attainment of the form of any animal Furthermore, Lund has succeeded in showing that by altering the electrical polarity it is possible by minute currents to alter the character of the development, thus showing that my guess as to the importance of these currents in embryology was correct.

The physical chemical conception of the electrical nature of oxidation has, therefore, been of importance in interpreting the cause of the electrical phenomena of living things and has helped in the unraveling of the complicated mechanism of inheritance It explains at once the dependence of these electrical currents upon respiration and vitality, and accounts for their origin

In another way too this electrical theory of oxidation is of value although not many applications of the facts to medicine have yet been made It furnishes a basis for understanding why some things can be oxidized and others can not be Clark, in Washington, has particularly shown the relation between the ease of oxidation of any substance and what is known as the potential of an oxidizing electrode immersed in a solution in which the substance is undergoing oxidation. Among the results obtained by the use of this method has been the proof that when methemoglobin is formed in the blood there has been an oxidation of the iron in the hemoglobin molecule so that it has become ferric iron, whereas in the ordinary oxyhemoglobin the iron is not oxidized but is in the ferrous state. This discovery will probably eventually throw light on the mechanism of hemoglobin respiration and will perhaps enable us to

understand the nature of the union between oxygen and hemoglobin.

These are simply a few of the applications in medicine and cognate sciences of the fundamental conception of physical chemistry that all oxidation is a process of an electrical nature.

But there is a more important aspect even of this work than those presented The great problem of biology is the source and nature of our vitality It is known that as long as we live we continue to breathe and that variations in our vitality are accompanied by variations in tissue respiration and by electrical phenomena of the highest interest I will mention only one of these curious phenomena which has to do with the alteration of the electrical resistance of the body under stress of the emotions This phase of animal electricity was being particularly studied five or six years ago by Professor A. D. Waller, the able English physiologist, just before his death The effect of emotion was demonstrated to me by his son, Mr J C Waller An electrode moistened with salt water was put on the palm and another on the middle of the back of my hand and these electrodes were connected with a galvanometer It was then found that there was a current running through the tissues of my hand, from back to front or *vice versa* I do not for the moment recall which way it went, but that is of no consequence for our purpose When this current was balanced through the galvanometer by another current just equal to it and running in the opposite direction, the galvanometer mirror came to rest and the spot of light reflected from this mirror remained steady. A horn of a motor was then suddenly sounded behind me. The instant this noise was made the galvanometer mirror was deflected There was an instantaneous increase in the current through the palm of my hand, due either to an increased electromotive force or decreased resistance of some or all of the tissues of the hand under the influence of the emotion caused by the noise. The current through the galvanometer was thus increased and the spot of light swung off the scale of the galvanometer. After it returned to normal the following experiment was tried. Mr Waller picked up a pin where I could see him and started toward me saying: "I am going to prick you with this pin" The instant he said this and approached me, the current of my hand changed again and just in the same direction as before and the spot of light swung off the scale, so violent was the electrical disturbance set up by this remark and action.

Whatever explanation may be given of this curious alteration in the electrical resistance or e m f. of the body under the influence of emotion, in both these cases probably the emotion of fear, they are certainly sufficiently remarkable. They merit a careful study and, as you all know, Dr. Crile, with his great genius for seeing far into things, has at once attacked this very problem and brought it into relation with many diseased states. According to his view there is some kind of a reciprocal variation in resistance between the liver and brain

No one can predict the future, but I have a feeling that the investigation and elucidation of these curious electrical disturbances, which are usually correlated with oxidative changes and with the emotions, will ultimately throw great light on the nature of vitality, and also perhaps on the causes of disturbed personality, states of mind, which have at present no tangible clue as to their origin

Among the most important developments in physical chemistry of recent days has been the development of photochemistry This seems to be the great field of the immediate future Here there have been two very fruitful ideas or conceptions introduced which are playing havoc with old theories of chemistry and letting in a flood of light upon regions which have been obscure These two fundamental conceptions are (1), the idea that molecules and atoms may exist in several different forms, these forms differing in the amount of energy they contain, and (2), what is known as the quantum theory The quantum theory is the theory that energy is radiated through space in definite units which are called quanta A quantum of energy is numerically equal to the product of a constant, the quantum constant, of which the value is $6\,547 \times 10^{27}$ ergs seconds, multiplied by the frequency of the vibration of the energy radiated

The first of these conceptions, that atoms and molecules which are alike in other respects may differ in the amount of energy they contain and so behave differently, is due in large measure, in its later development at least, to the work of Baly, of Liverpool, but is an essential part of the conception of the atom developed by Niels Bohr Bohr showed that the atom of hydrogen might exist in several different forms, the single electron which it contains revolving about the positive center in several different possible orbits. When the electron was farthest out the electron orbit had the largest amount of potential energy in it; and as it was easily displaced from this position to one of the orbits nearer the nucleus, it radiated the difference of energy of the two orbits when it was displaced. This conception is of very great importance to physiology and medicine. It means that a substance which is in its stable and energy poor form, where it is very unreactive, may be raised by the absorption of energy to another form in which it is very reactive and unstable. Thus chlorophyll when

it absorbs energy from the sunlight passes the energy thus absorbed, or a part of it, into the oxygen of carbonic dioxide. The oxygen thus enriched with energy dissociates from the carbon atom, leaving the latter to unite with water to make the carbohydrates. The oxygen contains more energy and is larger than it was when in the form of carbon dioxide as some of the electrons are out in larger orbits. When this oxygen is drawn into our lungs and sent by the blood to the tissues it unites with the cells of the body and passes this imprisoned sunlight over to them, and it is in this way that we get energy The oxygen atom when it has lost its energy returns again to the form of the oxygen in carbon dioxide. If there is mentality, as well as energy, in sunlight, it is quite possible that we secure our mentality also from oxygen; and that in this way our vitality is derived from the sun. The energy passed to the living matter by the oxygen is in turn passed by it to the foodstuffs, which as they come into the body are in their most stable and unreactive form. The carbohydrates, fats and proteins, thus enriched by this energy which came from the oxygen, are rendered highly reactive and are enabled thus to change into the myriad of things they change into in the course of metabolism. Thus this conception of atoms having available energy in them and existing in different states, of which the most reactive may be called the living state, enables us to form a pretty clear idea of the fundamental metabolism of the body Above all, it makes clear for the first time why oxygen is necessary for the metabolism of the body, and why growth stops as soon as anesthesia is produced and respiration stops

Probably the most remarkable work along these lines of photochemistry is at present being done by Professor Baly, of the University of Liverpool, in England He has succeeded in making several typical vital syntheses by means of ultra-violet light. He has thus made possible a concrete theory of the origin of living matter on the earth's surface by the action of light.

This same conception makes clear also why light is necessary for the proper development of the bones and teeth Vitamine D, the antirachitic one, is indeed nothing else apparently than ergosterol which has been enriched in energy by the absorption of light It is either the enriched ergosterol itself, or a derivative of the enriched form

The second conception, that of the radiation of energy in quanta, is at present upsetting the old idea of light and matter It is having also an effect in biology Certain frequencies, or only certain quanta, are absorbed by the blood pigment, hemoglobin. It is a very important and wholly unsolved problem what becomes of this energy which is absorbed. Is it reradiated at a different wave-length or is it passed on to cholesterol or some other constituent of the wall of the red blood cell so as to make the antirachitic vitamine or some other vitamine? Why is the blood red? It must be that the particular light absorbed is of use to the body in some way or other. I leave this problem with you to reflect upon. It may be that the healing power of light on wounds may be an indirect effect of the absorption of light by the blood pigment rather than a direct effect upon the wound tissue itself. Perhaps its action in tuberculosis is also correlated with this red color. What we need is the study of the particular wave-lengths of quanta of energy which are made use of in tuberculosis and in the healing of wounds, in the prevention of rickets and so on. Perhaps each tissue may have a favorable reaction to some specific frequency of the light, absorbing certain quanta but not others

In the University of Cincinnati some very interesting experiments are being carried out along these lines It has been found for example that bacteria are not killed by all ultra-violet light rays, but only by certain specific wave-lengths And the enzymes are killed by other frequencies, so that it has been possible to sterilize various enzymes without in any way injuring them by exposing them to certain specific wave-lengths. This work of Professor Schneider and his associates may have very important results for the sterilization of vaccines, serums and so on. In other words, the lethal effect of light, and particularly of ultra-violet light, does not increase gradually as the wave-lengths of light used are shortened and the frequency and energy is increased, but no effect is produced until a certain frequency, a certain definite amount of energy, is reached when a very fatal action is found to occur There is no doubt that the application of the newer conceptions of radiant energy will greatly enlarge the usefulness of ultra-violet light, X-rays and ordinary light, in their therapeutic applications. Photochemistry is the newest of the branches of physical chemistry but it promises to be one of the most valuable in its medical applications.

Still another development of physical chemistry and physics of recent years promises to be of great value in biology. I refer to the cathode rays and radio-activity. The effects of negative electrons when shot out of atoms or poured upon living tissue from a cathode ray tube are remarkable I will first consider the latter way of applying them. The wonderful tube, recently perfected by Dr. Coolidge, of the General Electric Company, enables us to apply electrons to tissues in far greater dose and traveling with far greater speed than has been possible hitherto. What the ultimate effects of this electrical bombard-

ment of tissues are it is too soon to say. Certainly, however, their effects are striking in the extreme. When the cathode particles traveling at high speed strike any object they do several things. They cause many things to fluoresce. They generate also very short X-rays which penetrate the tissues much deeper than the cathode particles themselves can do Even a second of exposure of the belly of a rat to a sufficient dose will kill the animal not immediately, but after a certain time. The rays are extremely destructive, as the amount of energy thrown upon the spot by these particles moving almost with the speed of light is very great Whatever the ultimate usefulness in medicine of this tube may prove to be, it has placed in the hands of the investigator a new instrument, and we may look forward with confidence to useful knowledge derived from its employment

But one of the most interesting of the recent works in this direction is that of the Dutch physiologist, Zwaardemaker We have atoms within us which are generating these cathode rays. So far as we know at present the element potassium is the only element in the body which is radioactive It is the only element which generates cathode rays at any other than very rare intervals The whole of the very weak radioactivity of our tissues is due to the presence of this element. Some atoms of potassium are going to pieces every second in our bodies. When they do so disintegrate they discharge a negative electron which is moving at about two thirds of the velocity of light and the rest of the atom changes into something else. What that something else is, is not known, I believe. A negative electron moving almost with the velocity of light may cause very remarkable things to happen in any molecule it passes through. Potassium is for some reason necessary for all forms of life. Howell found that it was necessary in the heart for the impulse from the vagus nerve to reach and stop the heart. Zwaardemaker has suggested that it is necessary perhaps for the sensitivity of every synapse in the body.

Zwaardemaker has made the following calculations:

There are in the body about 40 grams of potassium. This is an enormous number of atoms It is approximately 6×10^{23}. The radioactivity of potassium is small when compared with radium. It is only about four one millionths as active as radium. The total number of atoms decomposing per second is not large, but in the body it is 80,000. Eighty thousand atoms of potassium then are decomposed in our tissues every second and discharging this number of electrons at a very high velocity. These electrons have 0.022 ergs of kinetic energy, or they furnish 1,900 ergs per day. This is 45 microgram-calories. The amount of energy thus liberated is hence very small, almost inconceivably small. It is in the ratio of 1 · 35.5 billions when compared with the whole basal metabolism. But small though it is it may be of very great importance Zwaardemaker states that it is possible to replace the potassium in the perfusion fluid of the heart with an equal dose of other radioactive material such as radium emanation or uranium. He computes that in one eighth of a cc. of our bodies there are eight trillion potassium atoms, of which each second one arrives at the end of its life as potassium and changes into something else, at the same time shooting out of its nucleus a single negative electron with one third microerg of energy. Of this energy one half is lost in 1 mm., and in 2 mm. only one fourth remains. This charge traveling at high speed will effect the molecules it passes through. Every part of the one eighth of a cc. is every second subjected to this influence. In muscle and nerve especially this is happening, as they contain the most potassium, in bone and lungs it is almost absent. Therefore, says Zwaardemaker, every second there is a stimulus of one third microerg applied in every one eighth cc. of the body "In the presence of the proper receptors noticeable results from a stimulus of this size might be expected." "For example, the minimum energy perceived by the eye is about 0.7×10^{-10} ergs The energy of a beta particle from potassium is 4,000 times this A star of the first magnitude twinkles at night with 30 to 40 times less energy than that of a potassium atom when it explodes. The amount of energy necessary for the ear to hear is 0.3×10^{-8} ergs per second on the drum. In 17 thousandths of a second, the minimum time necessary for the perception of sound, this would give 1.1×10^{-10} ergs, which is the one twenty-five hundredth part of that of a potassium atom on exploding. The energy of an ordinary conversational voice at two meters distance is figured to be on the ear drum 1×10^{-9} ergs The potassium atom has 275 times this amount Zwaardemaker suggested in this way that the energy thus set free in the proper place and with the proper receptors to catch it may be a very important factor in the automaticity and activity of the nervous and muscular and other systems of the body.

There are still other even more fundamental conceptions than any yet quoted from the field of physical chemistry, which will probably in the course of time be applied to biology and medicine. These are the new conceptions of the nature of time and mass and energy which have already upset all the foundations of mechanics and physics Their effects on biology are already beginning. No one can say what they will do to and for this science; they seem, however, to have the effect of putting mentality of some kind into the inorganic as well as the organic and thus

to open entirely new vistas in biology. They suggest a method by which matter can be made, and they offer, or seem to offer, an escape from the purely mechanistic theories of conduct and life. It would take much longer, however, to consider these revolutionary conceptions than we have time for to-night, and I will only call your attention to them in passing Those of us who are alive twenty years from now will probably in that time have passed through a revolution of biological thought as great as any the world has ever seen And this revolution will unquestionably have important consequences for the physician and his patient.

I have by no means exhausted the applications of physical chemistry to medicine In fact, I have mentioned only a very few which have particularly interested me But I shall have compassion on you and stop with these.

I believe and hope that the development in our knowledge of energy and matter and vitality, developments which are impending, will stimulate above all the science of therapeutics, that step-child Cinderella, at present hardly tolerated, and boxed about most unkindly, to our great disgrace, in every American medical school. I believe physical chemistry, or physics with chemistry, is spinning for her a new dress, a dress shining and splendid. Once bedight in it she will dazzle the eye and warm the heart of even the oldest, most experienced and most cynical among us, and be seen for what she is, the fairest daughter among the medical sciences And I venture to say that in no way can the science of physical chemistry serve medicine better, playing the rôle of Prince Charming, than by leading this Cinderella from her position of drudge to the throne of medicine

For it is the neglect of therapeutics, which is, I believe, one of the most serious shortcomings of present-day medicine And it is in this field that physical chemistry can contribute most.

ALBERT P. MATHEWS

UNIVERSITY OF CINCINNATI

THE ABUSE OF WATER[1]

IT would appear obvious that the fundamental principles of science must not be dependent upon any casual feature, such as environment Thus the laws of gravitation should be just as rigid on the sun or the moon as on the earth In a science which is mainly experimental, also, such as chemistry, it would seem to be a simple matter to insure that the results of experiments were not being misinterpreted due to their environment. This might be done either by changing the conditions under which the experiments were being conducted, or by a rigorous study of the existent conditions and of their possible influence. Nevertheless, the history of chemistry affords numerous instances where whole schools of investigators have gone astray through neglect of such precautions.

A noteworthy example is given by the famous phlogiston theory, which predicated that substances which were changed by heat did so through loss of phlogiston We now know that such substances are actually changed through combination with the oxygen of the air in which they are heated, but this explanation did not secure acceptance until the nature and properties of oxygen had been thoroughly investigated and until the effect of heating substances in the absence of oxygen had been noted At the present time, we still allow our oxygen environment to influence our definitions to some extent We call a body "combustible" if it burns in the air, and "non-combustible" if it does not That such terms have no strict scientific meaning is evident if we imagine ourselves to be translated, for a moment, to a world in which the atmosphere contained hydrogen as an active component instead of oxygen. In such a world fires would be extinguished by sprinkling gasoline on them, and non-inflammable buildings would consist of solid paraffin

The modern science of physical chemistry has been almost wholly developed through the study of very dilute aqueous solutions, and a scrutiny of this water environment suffices to show us that our present viewpoint is considerably distorted and incomplete in many respects Water itself is almost as much a mystery to the chemist of to-day as oxygen was to Priestley We call it H_2O in the text-books, but liquid water certainly does not consist of simple molecules of H_2O What the actual complexes are, and how they are changed on addition of a solute, are points on which we are entirely ignorant The theory of dilute solutions founded by van't Hoff avoids the difficulty by assuming that we may regard the solute as existent in the gaseous state, neglecting the water absolutely as so much "dead space" This idea, though still popular in the classroom, has been shown by the more modern theory of ideal solutions to be quite erroneous. There is no direct analogy between solutions and gases, a substance such as sugar, when dissolved in liquid water, is not in the gaseous state but in the liquid In a liquid solvent, solution and fusion are identical terms; sugar melts in hot tea just as ice melts in iced tea The two components of a solution, solvent and solute, must be considered as equally important, but at present our procedure is to let familiarity breed contempt and to

[1] Abstract of an address delivered before the Institute of Chemistry of the American Chemical Society, State College, Pa, July 28, 1927.

ignore the water altogether. Consequently the identity of freezing-point depression and solubility laws is seldom made apparent to the student, he is taught the same fact twice under two different names

When hydrogen chloride HCl is dissolved in water H_2O, two substances which do not conduct the electric current separately give a solution which is an excellent conductor. We "explain" this by assuming that the hydrogen chloride HCl is split up, or ionized, into positively charged H^+ and negatively charged Cl^-, and that the migration of those ions towards the electrodes accounts for the conductance Why, in a mixture of HCl and HOH, two substances with perfectly similar characteristics, should one be active and the other quite inert? Simply because we are so familiar with water (or think we are) that we do not trouble to take it into consideration Suppose we lived in a world in which another liquid, say sulphuric acid, was the familiar reference liquid, and suppose that in this world an ingenious chemist discovered a hitherto unknown substance, water He would put a little of it into the practically non-conducting solvent, 100 per cent H_2SO_4, and would decide that the solution was an excellent conductor This would apparently justify the announcement in the scientific press that the new compound HOH was highly ionized in a solution—a typical strong electrolyte—a very polar substance—almost completely broken up into H^+ and OH^- Yet the chemists of another world, in which acetic acid was the reference liquid, would agree that water was a weak electrolyte, and those of a third world, in which ethyl alcohol was supreme, would call it a non-electrolyte

Evidently, to develop a consistent theory of conducting solutions, we have again to insist on the equality of solvent and solute We can not obtain a true conception of ionization, either by the classical theory of Arrhenius or by the more recent theory of Debye, unless we consider the two components of a conducting solution impartially A theory of ionization has been presented by Werner, indeed, which goes to the opposite extreme, regarding water as the *only* substance which ionizes directly in aqueous solution. This theory is just as good as the currently accepted view, and leads to the same mathematical conclusions

That the study of systems in a non-aqueous environment will certainly develop results of great significance in chemistry has been shown by the excellent work of Franklin and his coworkers on reactions in liquid ammonia. That the closer study of water itself will open up new avenues of advance has been clearly indicated by the remarkable work of Baker on systems from which the last minute traces of water have been removed. Instead of being a substance which can be neglected, water is perhaps the most reactive of all substances. When we cease to abuse it and recognize its proper importance, a new and more general chemistry of solutions will be born.

JAMES KENDALL

NEW YORK UNIVERSITY

FRANK W VERY

WITH the death of Frank Washington Very on November 23, 1927, there ended the earthly career of an active investigator in the fields of astrophysics, meteorology and aerodynamics Born in Salem, Mass, in 1852, the son of Washington and Martha (Leach) Very, he specialized in chemistry at the Massachusetts Institute of Technology and received his degree of bachelor of science there in 1873 He entered the field of astronomy and became first assistant at the Allegheny Observatory, 1878–1895, under the direction of Dr S P Langley, was professor of astronomy at Western University, Pennsylvania, 1890–1895, and director of Ladd Observatory of Brown University, 1896–1897 Afterward he was engaged in researches on astrophysics and other allied sciences at Westwood, Mass In 1893 he married Portia Mary Vickers, of Glenshaw, Pa, and there survive five children, Arthur, Ronald, Mrs E R. Brown, Mrs A C Bartlett and Miss Marjorie Very Very was a pioneer in several fields of science and loved the work of the pioneer

He was a man of great originality and had an intense enthusiasm in the pursuit of knowledge His activities in science covered a wide range of subjects He assisted Langley for ten years in his epoch-making work in astronomy and in the aerodynamic studies on which Langley based his model flying machine weighing 25 pounds which successfully flew over the waters of the Potomac He assisted Frank W Bigelow in the preparation of his books on the thermodynamics of the atmosphere and cooperated with Percival Lowell in his studies of the atmospheres of the planets In 1900 he was at work with radio experts in devising a system of signals for our weather bureau by means of which information from vessels at sea might be received by radio then in its early stages. He also assisted Dr Williams in the study of the application of X-rays to medical practice. At the same time he was carrying on a large amount of original work on his own account Probably his greatest contributions to science were his studies of the moon's surface temperature and his studies of the absorption of heat by our atmosphere, each of which filled a large volume when published. The last was published as "Bulletin G" by the United States Weather Bureau in 1900. By ingenious methods he

applied the bolometer, invented by Langley, to the problem of lunar temperatures and showed that at lunar midday the moon's surface, unprotected by an atmosphere, rose to a temperature exceeding that of boiling water, while at night the temperature fell far below the freezing point

This was the pioneer effort in the measurement of the surface temperatures of the moon and planets which have since been carried on so successfully by Slipher, Coblentz and others Our knowledge of the absorption of solar heat by our atmosphere, in spite of the large amount of work on its investigation, is still largely undeveloped, so that Very's work stands to point the way to others

Very was of a philosophical temperament and he was never so happy as when speculating on the great problems of the universe. His conclusions were frequently out of the ordinary beat and there were sometimes developed sharp differences with his fellow investigators, but he amiably took these differences as part of what was to be expected in life and went on uninterruptedly with his tasks.

He was profoundly impressed by the contributions of Swedenborg to philosophy, science and religion and during the last years of his life was engaged in explaining these contributions in the language of modern science

His task in life was to enlarge the boundaries of human knowledge and to show that there was no conflict between science and religion He worked with these ideals ever in view

H H. Clayton

Canton, Mass

SCIENTIFIC EVENTS

BUILDING PROGRAM OF THE U. S DEPARTMENT OF AGRICULTURE

The plans for the building program for the U S Department of Agriculture in Washington were announced by the Treasury Department on November 16, according to a statement in the *Official Record* of the department They indicate that when the whole program is completed the Department of Agriculture will be housed in one of the largest office structures in the world Bids were opened on December 8 for the excavation work for the building, which will connect the present east and west wings This unit will be the first to be built under the plans The Department of Justice is arranging for condemnation proceedings for the acquisition by the government of the first of three squares of private property which eventually will be occupied by the structure These three squares are those between B and C Streets and between Fourteenth and Twelfth Streets, S W.

The plans call for an extensible building, one that may be added to indefinitely according to requirements for space in the future. The unit that is to be built first, the one filling in between the present east and west wings, will complete the façade on the Mall. B Street will not be closed. On the south side of B Street, immediately and symmetrically behind the marble structure in the Mall, will be a five-story unit more than 1,000 feet long over all from east to west Behind this unit other units will be built as time goes on as the need for more space requires. The extensible building will follow a gridiron scheme with an axis perpendicular to the center of the administration unit in the Mall

The extensible building will run from Fourteenth Street to Twelfth Street Eventually Linworth Place and Thirteenth Street between B and C Streets will be closed and the space occupied by the buildings and its courts

Although the extensible building will be less monumental in nature than the administration building in the Mall, it will have a north façade along B Street of impressive dignity

The new central unit connecting the present wings is to cost not more than $2,000,000, and the congress has appropriated $400,000 toward this particular part of the program For the total cost of site and construction of the extensible building south of B Street congress has authorized a total expenditure of $5,750,000 and has already appropriated $1,200,000 of this amount

The new unit which is to join the wings is to be about 176 by 170 feet on the ground and that unit of the extensible building which will be built first will be 241 feet by 483 feet on the ground.

GUIDE-LECTURE TOURS AT THE FIELD MUSEUM

Beginning on December 1 a new system of guide-lecture tours was instituted at the Field Museum of Natural History, according to an announcement by D C. Davies, director of the museum.

These tours, a service for which no charge is made, are designed to aid visitors with a limited amount of time at their disposal to find easily and enjoy the best exhibits among the institution's large collections from all ages and all parts of the world, and to assist persons interested in particular subjects to get the most out of the exhibits illustrating those special subjects.

Under the new plan there will be every Thursday, starting at 11 a. m. and 3 p. m., two general tours touching the important exhibits of all four departments of museum exhibits—anthropology, botany,

geology and zoology. These will provide a quick, convenient survey of the most striking features for the visitor who has but little time to spare. The guide lecturers conducting the parties will give informative talks before each of the exhibits

On the other days when guide-lectures are to be given—Mondays, Tuesdays, Wednesdays and Fridays—individual sections of the museum will be studied, each subject being treated in more detail Each month a schedule will be drawn up and announced, so that the person with specialized interests may come when his subject is to be taken up Eventually, under this plan, all sections of the museum will receive this specialized study treatment Persons with a variety of interests may profitably attend a large part or all of the lectures Students of high schools, colleges and universities are expected to find the guide-lecture courses particularly valuable as a supplement to their regular studies

Following is the schedule of guide-lecture tours for December, in addition to the Thursday general tours

Dec 2—11 00 A M, Eskimos.
3 00 P M., Systematic mammals.
Dec 5—11 00 A M, Northwest coast Indians
3:00 P M, Precious and base metals, building stones.
Dec 6—11·00 A. M, Woodland Indians
3 00 P M., Plant life
Dec 7—11 00 A. M., Great plains Indians
3.00 P M., North American and African game animals
Dec 9—11·00 A M, California Indians, nomadic tribes of southwest
3·00 P. M., Petroleum, coal, clays, sands.
Dec 12—11.00 A. M, Sedentary tribes of southwest
3 00 P M, Skeletons
Dec 13—11·00 A. M., Archeology of Mexico
3:00 P M., Economic botany
Dec 14—11·00 A. M, South American Indians
3·00 P. M, Systematic minerals and meteorites.
Dec 15—11.00 A. M., Melanesia
3.00 P. M., Fish and reptiles
Dec 19—11:00 A. M., Italian archeology
3:00 P. M., Physical geology.
Dec 20—11:00 A. M, China.
3:00 P. M., Gems
Dec 21—11:00 A. M., Tibet
3:00 P M, Marine invertebrates.
Dec. 23—11:00 A. M., Children's toys of the world.
3:00 P. M., North American trees.
Dec 27—11:00 A. M., Reindeer and relatives.
3:00 P M., Life of birds.
Dec. 28—11:00 A. M., Historical geology
3:00 P. M., Textiles.
Dec. 30—11:00 A. M., Pewter and glass.
3:00 P. M., Systematic birds.

THE CLEVELAND MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA

THE official program of the mid-winter meeting of the Geological Society of America, to be held in Cleveland, December 29, 30 and 31, has been issued. Three affiliated and closely associated societies, the Paleontological Society, the Mineralogical Society of America and the Society of Economic Geologists, will hold meetings at the same time and place Section E of the American Association for the Advancement of Science, which will meet at Nashville, announces its program also with this geological group, although its meetings are separate this year

The program is expected to occupy three days, with almost continuous sessions and many sectional meetings. One hundred titles are listed on the geological society program alone, and the total of the four societies meeting at Cleveland will exceed one hundred and fifty, representing studies in nearly all branches of this earth science

Major interest this year centers around large tectonic problems as represented by the symposium on "New Data on North American Structures." No less than twenty-five papers deal primarily with structural questions

The principal addresses will be as follows

Arthur Keith, president of the Geological Society of America, "Structural Symmetry of North America."

William A. Parks, president of the Paleontological Society, "Some Reflections on Paleontology"

Austin F Rogers, president of the Mineralogical Society of America, "Natural History of the Silica Minerals"

Frederick L. Ransome, president of the Society of Economic Geologists, "Directions of Progress in Economic Geology"

The annual dinner will be held on Friday evening, December 30, at the Hotel Cleveland, at which time the newly established Penrose medal for distinguished achievement in geologic science will be awarded

CHARLES P BERKEY,
Secretary

PRESENTATION OF THE ROYAL SOCIETY MEDALS

THE awards of the Royal Society Medals have already been recorded in SCIENCE. Sir Ernest Rutherford, president of the society, in presenting the medals to Professor A. A Noyes, Dr. W. D. Coolidge and Professor J. C. McLennan made the following citations:

The Davy Medal, awarded to Professor Arthur Amos Noyes

Professor Noyes's researches have been chiefly concerned with the properties of solutions, in particular of

electrolytic solutions Soon after the inception of the electrolytic dissociation theory of Arrhenius, it was recognized that all was not well with the strong electrolytes. Whilst qualitatively their properties were accounted for by the theory, there yet existed marked quantitative discrepancies. Accurate measurement of the properties of such solutions was the first requisite for the attack of the problem, and to this task Noyes applied himself His investigation of the conductance of aqueous solutions up to temperatures as high as 300° forms a classical example of exact physicochemical measurement executed under conditions of great experimental difficulty

His work on the influence exerted by one salt on the solubility of another, on transport numbers and the mobilities of the ions, on the ionization of pure water at different temperatures, is all directed to the same end Noyes showed the importance of the classification of the strong electrolytes according to their valency type and, more than twenty years ago, attempted to take into account the electrostatic forces between the ions. He thus foreshadowed the modern theory now so widely developed by Noyes himself amongst other workers

The Hughes Medal, awarded to Dr William David Coolidge

Science is under a great debt to Dr Coolidge for the invention and production of a new type of X ray tube, called by his name, of great flexibility and power, which has proved of great service not only to medical radiology but also in numerous scientific researches. In the last few years he has applied his unrivalled technical knowledge to the generation of high velocity cathode rays, which can be passed into the air through a thin window as in Lenard's pioneer experiments thirty years ago Such researches are of great importance to science, as they promise to provide us with new methods of obtaining a copious supply of swift electrons and high-speed atoms of matter for experimental investigations

A Royal Medal, awarded to Professor John Cunningham McLennan

For more than thirty years Dr J C McLennan has been an industrious and enthusiastic experimenter, his papers being mainly concerned with radioactivity, gaseous conduction of electricity, the spectra of the elements and the liquefaction of gases Among his works of outstanding merit may be mentioned the measurements he has made with his pupils on the fine structure of spectral lines, which are of much importance to modern theories of the mechanism of the atom Recently he has had quite sensational success in tracing to its source the elusive auroral line λ5577, an extremely difficult task which had baffled the skill of many previous investigators This is important not only in itself but also on account of the information it yields as to the structure of the upper atmosphere Apart from his own private researches he has built up a most efficient school of physics in Toronto, and is largely responsible for the present strong position of physical science in Canada. He has devoted much energy to the establishment of a cryogenic laboratory in Toronto, a heavy task which he has carried out with much success.

SCIENTIFIC NOTES AND NEWS

The Edison medal, conferred annually by a committee of the American Institute of Electrical Engineers for "meritorious achievement in electrical science, electrical engineering or the electrical arts," has been awarded for the year 1927 to Dr William D Coolidge, assistant director of the research laboratory of the General Electric Company, "for his contributions to the incandescent electric lighting and to the X-ray arts"

The Catherine Wolfe Bruce gold medal of the Astronomical Society of the Pacific, given annually for "distinguished services to astronomy" upon the nominations made by six of the world's great observatories, has been awarded for 1928 to Dr Walter Sydney Adams, director of the Mount Wilson Observatory The formal presentation will be made in the early part of next year Since its foundation in 1897, the medal has hitherto been conferred upon Simon Newcomb, Arthur Auwers, David Gill, Giovanni V Schiaparelli, William Huggins, Herman Carl Vogel, Edward C Pickering, George W Hill, Jules Henri Poincaré, Jacobus C Kapteyn, Oskar Backlund, W. W Campbell, G. E Hale, Edward Emerson Barnard, Ernest William Brown, Henri A Deslandres, Frank W Dyson, E B Baillaud, A S Eddington, Henry Norris Russell, R G Aitken and Herbert Hall Turner

The board of managers of the Franklin Institute has voted to award to Dr. Vladimir Karapetoff an Elliott Cresson gold medal, "in consideration of the inventive ability, skill in design and detailed theoretical knowledge of kinematics and electrical engineering displayed in the development of computing devices" This medal will be presented at the annual medal day meeting of the institute, which will be held on May 16, 1928.

On the occasion of a celebration, marking the fiftieth anniversary of the founding of the Engineers' Club of Philadelphia, the University of Pennsylvania conferred the degree of doctor of science upon the following engineers on December 10 John Hays Hammond, of Washington, past-president of the American Institute of Mining Engineers; Charles M. Schwab, of New York, honorary member of the Engineers' Club and president of the Iron and Steel Institute, and Howard Elliott, of New York, chairman of the board of the Northern Pacific Railway.

At the annual meeting of the American Society of Mechanical Engineers in New York, the Melville medal, awarded for the first time, was given to Leon

P. Alford, editor of *Manufacturing Industries*, for his paper on "The Laws of Management."

The Alvarenga prize for 1927 has been awarded by the College of Physicians of Philadelphia to Dr Emil Bogen, of Cincinnati, Ohio, for his essay entitled "Drunkenness" The next award of the prize, amounting to about $300, will be made on July 14, 1928

Dr. George Grant MacCurdy, of Yale University, director of the American School of Prehistoric Research, has been elected a corresponding member of the Société des Americanistes de Belgique

Nature states that the Hopkins prize of the Cambridge Philosophical Society has been awarded as follows For the period 1912–15, to Professor R A Sampson, astronomer royal for Scotland, for his researches on the internal constitution of the sun, on optical systems, on Jupiter's satellites and on practical chronometry, for the period 1915–18, to Sir Frank Dyson, astronomer royal, for his contributions to the general progress of astronomy and to the spectroscopy of the solar atmosphere, for the period 1918–1921, to Professor A S Eddington, Plumian professor of astronomy and experimental philosophy in the University of Cambridge, for his work on the classification of the motions of the stars, and on their structure, and on the influence of gravitation on rays of light; for the period 1921–24, to Dr J. H Jeans, secretary of the Royal Society, for his work on the theory of gases, and on radiation and on the evolution of stellar systems.

Professors A Einstein, of Berlin, O. Holder, of Leipzig, F Schur, of Breslau, and E Study, of Bonn, have been elected corresponding members of the Bavarian Academy of Sciences

The following appointments have been made in the British Museum of Natural History Dr L J. Spencer, to be keeper of mineralogy, in succession to Dr G. T. Prior, who retired on December 16, Dr W. D. Lang, to be keeper of geology, in succession to Dr F. A. Bather, who retires next February, after forty years of service in the museum, J. Ramsbottom, to be a deputy keeper in the department of botany, on the promotion of Dr. Spencer; M. A C. Hinton, to be a deputy keeper in the department of zoology, on the promotion of Dr. Lang.

The Zoological Society of London has elected S. Zuckerman, M A., University of Cape Town, to its research fellowship in anatomy, and Miss Eleanor Margaret Brown, B.Sc., University of London, to its aquarium research fellowship

Paul H. M.-P Brinton, professor of chemistry and head of the division of analytical chemistry in the University of Minnesota, has severed his connections with the university, and will devote his time to private research in rare element chemistry at Pasadena, Calif.

Clark C. Heritage has been appointed to the vacancy caused by the resignation of John D Rue, former chief of the section of pulp and paper in the Forest Products Laboratory

C W Larson's resignation as chief of the Bureau of Dairy Industry was announced on December 1 by Secretary of Agriculture Jardine The resignation will be effective at the end of this year, when Dr. Larson will become the director of the National Dairy Council

Bruce Cartwright has been appointed an associate in ethnology on the staff of the Bernice P Bishop Museum. He has recently been engaged in mapping ruins on the Island of Molokai

According to *The Experiment Station Record*, Geoffrey Evans, formerly in the Indian Agricultural Service, has been appointed principal of the Imperial College of Tropical Agriculture Henry A Ballou, professor of entomology and head of the section of entomology and zoology, has been appointed by the British government to the newly established office of commissioner of agriculture for the British West Indies. He will retain his connection with the college, but will be occupied largely in an attempt to coordinate the scientific and practical work of the institution and the departments of agriculture of the various islands

Paul C Standley, of the U S National Museum, sailed from New York on November 26, to spend the winter in botanical field work in Honduras The work is being undertaken in cooperation with the Arnold Arboretum and the United Fruit Company

James L. Peters, associate in ornithology at the Harvard Museum of Comparative Zoology, and Edward Bangs started on November 29 on an ornithological expedition to the Corn Islands, off the coast of Honduras They will also study the birds of an unfrequented desert region in Nicaragua, returning to this country in the late spring

Dr Ralph Linton, of the Field Museum of Natural History, recently returned from a two-year tour of Madagascar, where he assembled information indicating an ancient migration of people of an Asiatic origin to Southern Africa and Madagascar.

Dr G. J Hucker, associate bacteriologist at the New York State Agricultural Experiment Station, has returned after fifteen months spent in laboratory investigations at the Royal Polytechnical Institute at

Copenhagen and at the Lister Institute at London, under the auspices of the International Education Board.

Dr. E. C. Gray, exchange investigator of the League of Nations, after staying in Tokio for some time to investigate food problems in the government institute for nutrition, has left for England

Dr. Luis Maria Torres, director of the Natural History Museum, La Plata, Argentina, recently concluded a visit to England, during which he worked at the Natural History Museum, South Kensington, London.

Dr. C E Spearman, of the department of psychology at the University of London, is visiting the United States as the guest of the Commonwealth Fund

Professor J W McBain, of Stanford University, will give a series of five lectures in the department of chemistry at the University of Arizona during the first week of January The general topic of these lectures will be. "Sorption Its Nature and Mechanism"

At the recent intersectional meeting at Cornell University of the Western New York, Rochester, Syracuse and Eastern New York Sections of the American Chemical Society the main lecture was given by Dr. Colin G Fink, of Columbia University, on "Recent Advances in Applied Electrochemistry" On the morning of December 10 Professor Paul Walden, of the University of Rostock, lectured on the "Walden Inversion."

The regular meeting of the Nebraska section of the American Chemical Society was held on December 1 Dr W D. Bancroft, of Cornell University, addressed the section on the subject of "Air Bubbles and Drops."

Dr. James A Tobey, of New York, lectured on public health law at the Harvard University School of Public Health on December 7 and 9

Captain M E Odell, of Toronto, addressed a joint meeting of the Washington Academy of Sciences and the Geological Society of Washington on December 7, on the "Scientific Aspect of the Mount Everest Expedition."

Dr. F. O Rice, associate professor of chemistry in the Johns Hopkins University, addressed the New York University chapter of Sigma Xi on December 16, on "Suspended Particles in Gaseous and Liquid Systems."

Professor H. B. Ward, head of the department of zoology at the University of Illinois, gave a public address under the auspices of the University of Iowa on December 6. The subject was "The Significance of Life."

Dr. George Smith, director of the United States Geological Survey, will be the commencement speaker at Colby College next June. Dr. Smith was graduated from the college in 1893, and has been a trustee since 1903

Dr. Harlow Shapley, director of the Harvard College Observatory, gave on December 14, before the department of astronomy of the Brooklyn Institute of Arts and Sciences, an illustrated lecture on "Measuring the Milky Way"

Dr. Robert Andrews Millikan, chairman of the administrative council of the California Institute of Technology, gave on December 14 the first of a series of lectures to be presented by visiting lecturers at Lafayette College on The Lyman Coleman Lecture Foundation for 1927–28

Dr. C Macfie Campbell, professor of psychiatry in the Harvard Medical School, recently delivered the eighth Pasteur lecture before the Institute of Medicine of Chicago on "Some Problems of the Functional Psychoses"

The rector of the Charles' University and the dean, of the faculty of science, Prague, Czechoslovakia, have announced a course of lectures by Professor M. T Bogert, of Columbia University, as the first visiting Carnegie professor of international relations to Czechoslovakia. The lectures are five in number, the first having been given on November 16, and the last being scheduled for January 18

The first meeting of the executive committee of the American Association for the Advancement of Science will take place at 10 00 on Monday morning, December 26, in the executive committee parlor at the Andrew Jackson Hotel. The committee will meet at the George Peabody College for Teachers (Room 101, Industrial Arts Building) at 10:00 a. m on Tuesday, Wednesday, Thursday and Friday from December 27 to 30. The council will meet in the Andrew Jackson Hotel Monday afternoon, December 26, at 2:00 o'clock. This will be the most important council session Other council sessions are to occur at the George Peabody College for Teachers (Room 101, Industrial Arts Building) at 9:00 a. m. on Tuesday, Wednesday, Thursday and Friday. These sessions are to close by 10 00 o'clock. All members of the executive committee are members of the council. The chairman of the council is the president of the association. At 6·30 on Friday evening will occur, in the Andrew Jackson Hotel, the annual, complimentary, informal dinner and conference of the executive com-

mittee and the secretaries of the sections and of the societies meeting with the association at Nashville The annual secretar y' conference is to follow the dinner.

AMONGST the societies not meeting during Christmas week in connection with the meeting of the American Association for the Advancement of Science at Nashville it may be noted that the meetings of the American Astronomical Society and of the American Section of the International Astronomical Union will be held at Yale University The Society of American Bacteriologists will meet at Rochester, N Y, and the Geological Society of America, the Paleontological Society, the Mineralogical Society of America and the Society of Economic Geologists will meet at Cleveland, Ohio The American Psychological Association meets at Columbus, Ohio, and the American Anthropological Association at Andover, New Hampshire. The Archeological Institute of America will meet at Cincinnati with the College Art Association of America, the American Philological Association, the Linguistic Society of America, the National Association of Teachers of Speech and the American Association of University Professors The meetings of the American Sociological Society, the American Political Science Association, the American Economic Association, the National Community Center Association, the American Association for Labor Legislation, the American Statistical Association and the American Historical Association will be held at Washington, D C.

THE next annual meeting of the American Society for Testing Materials will be held at Atlantic City in the Chalfonte Hotel from June 25 to 29

THE London correspondent of *Industrial and Engineering Chemistry* writes that preparations are now being made for the celebration next month of the jubilee of the Institute of Chemistry of Great Britain and Ireland. The institute, of which R. B Pilcher has been for many years the secretary and registrar, has done a great deal of work for the development of chemistry as a recognized profession and its degrees of "fellowship" (F.I C.) and "associateship" (A I C) rank high both as academic and practical qualifications. The jubilee celebrations will include a joint dinner, at which a very large attendance is expected, a reception and various other features.

THE first number has been issued of the *Quarterly Journal of General Psychology*, established by the late Edward Bradford Titchener and Professor Carl Murchison, and published by the newly established Clark University Press of which Professor Murchison is the director. The journal is planned to cover experimental, theoretical, clinical and historical psychology and has the cooperation of a number of editors representing different countries and the more important fields of psychology.

WORD has been received at the Harvard College Observatory from J Hartmann, director of the observatory at La Plata, Argentina, that Maristany, also of La Plata, has observed a second magnitude comet with a tail The detailed observation of the comet was right ascension 16 hours 27 minutes, declination minus 50 degrees The Harvard observers stated that this comet was apparently the one discovered by S. K Jellerup, a South African astronomer, at Cape Town.

THE Rockefeller Foundation has offered the University of Copenhagen a gift of half a million kroner for the erection and equipment of an institute of physical chemistry on condition that the Danish Government provides the site and maintains the work of the institute The Rockefeller Foundation has previously provided funds for the erection of an Institute of Theoretical Physics and an Institute of Physiology, both of which are now in course of erection

UNDER the will of Nathan Matthews, former mayor of Boston, Harvard University receives a portion of Mr Matthews's, estate in Hamilton, known as Black Brook Farm, which has been planted and maintained as an experimental forestry station The will directs that the station be continued for the benefit of all persons and institutions in New England interested in forestry.

THE late Professor A Liversidge, F.R S., has bequeathed to the department of minerals of the British Natural History Museum his mineralogical collection, comprising 3,000 specimens, mainly from Australia. This bequest includes a 65 pound mass of the Thunda meteoric iron and about 40 other specimens of meteorites, about 40 sections of gold nuggets, cut to exhibit their internal structure, and about 40 gem stones, besides lantern and microscope slides, photographs, etc The trustees have authorized the purchase for the same department of two fine specimens of Dioptase crystals from the French Congo In this connection they acknowledge the generosity of Mr. F. N Ashcroft, who contributed half the cost of the best specimen.

PART of the famous Santa Rosa gardens, where Luther Burbank conducted many of his experiments with plant life, will be given to the municipality for a public park. Mrs. Burbank, having decided to sell three quarters of the three-acre garden plot for cutting up into building lots, is retaining the remaining quarter, on which is situated the Burbank home and the cedar of Lebanon, beneath which Burbank is buried, and this will ultimately be left in trust to the public.

BARRO COLORADO, an island in Gatun Lake, Panama Canal Zone, has been reproduced in miniature at the American Museum of Natural History, with its wealth of bird and animal life and tropical foliage The exhibit was opened to the public on December 9 The island is the first of a series of twelve groups planned to illustrate bird life in the major faunal zones of the world Barro Colorado is to be typical of the American tropics The group was presented by Dr Evan M Evans, who was assisted in his work by Dr Frank M Chapman, ornithologist, Francis L Jaques, who painted the background, and Raymond L Potter, who mounted the birds The foliage was reproduced in wax by James L Clark, of the museum

INDIAN objects and prehistoric relics, comprising the collection owned by Mr Jonathan Tibbet, of Riverside, will soon be permanently exhibited at Pomona College as the gift of Mr and Mrs Tibbet, according to an announcement made by Mr. J H. Batten, director of regional service for the college The gift contains between five and six thousand separate articles, some of which date back to prehistoric days The pioneer relics cover the entire period of California history, and have been secured from early families that Mr Tibbet personally knew or from other trustworthy sources

ACCORDING to a statement in *Nature* on the annual report of the British Photographic Research Association, the Department of Scientific and Industrial Research has offered to the association a block grant for the five years ending May 31, 1932, that will make up the income of the association from other sources (its members' subscriptions) to £5,000 per annum. There are certain conditions, and the one that is essentially new requires the appointment of a "research committee of technical and scientific persons in whom shall be vested the supervision of the scientific investigations of the association" Although the income of the association will probably be rather less than it has been, the useful work that it has been carrying on for the last ten years will be continued The report gives the details of the last year's work.

THE cooperating agencies composing the New England Research Council, including agricultural experiment stations, state bureaus of markets and some of the universities of New England, were represented at the annual meeting of the council in Boston the latter part of October, according to a report by Nils A. Olsen, assistant chief of the U S. Bureau of Agricultural Economics, in the *Record* of the U. S. Department of Agriculture He says that a very much worth-while review was presented of all the research work that is going on at the individual stations. A general discussion of methods and problems arising in connection with the elasticity of milk supply studies was led by Mordecai Ezekiel, an economist of the division of farm management and costs of the bureau.

THE 1927–28 prize essay contests of the American Chemical Society will be conducted in a manner similar to that of the past four years with funds which have again been provided by Mr and Mrs Francis P Garvin, of New York City Contests will be conducted for high-school pupils, with prizes totalling $6,000 in cash and six four-year university scholarships of $500 annually, for university and college freshmen, with prizes totalling $6,000 in cash, for normal school and teachers' college students, with prizes identical with the freshman contest The topics from which contestants must select subjects for their essays are: The relation of chemistry to health and disease, the relation of chemistry to the enrichment of life, the relation of chemistry to agriculture or forestry, the relation of chemistry to national defense, the relation of chemistry to the home and the relation of chemistry to the development of an industry or a resource of the United States

UNIVERSITY AND EDUCATIONAL NOTES

THE Princeton University $20,000,000 fund committee reports that over $6,500,000 is now pledged towards the objective of the Princeton fund, which is to secure an increased remuneration for the faculty and to make possible a building program for the university Toward the $2,000,000 fund for a foundation in pure scientific research over $1,400,000 is now pledged Upon completion of the $2,000,000 fund the university will receive from the General Education Board its conditional gift of $1,000,000 for this purpose

AMHERST COLLEGE has been promised a new chemical laboratory as the gift of Mrs William Henry Moore, of New York City, and her sons, Edward Small Moore and Paul Moore, as a memorial to her husband.

AT a dinner held in New York on December 2 by the Near East College Association, a gift was announced, among others, of $1,000,000 from the Rockefeller Foundation to be devoted to medical work at the American University of Beirut The Near East College Association announced at the dinner the opening of a campaign to raise $15,000,000 for the six American colleges in the Near East. Among other gifts announced was $1,000,000 from the estate of Dr. Charles Hall, who died in 1914.

THE University of Cambridge has become entitled to a bequest of approximately £65,000, accruing from

the residuary estate of the Rev J. H. Ellis, M.A, of Trinity, to be used for general purposes as thought fit

AT St. Louis University, Dr Alphonse M Schwitalla, A M, Ph.D, has been appointed dean of the school of medicine to take the place of Dr Hanau W Loeb, recently deceased, and Dr Don R Joseph, formerly vice-dean, was promoted to the position of associate dean Dr James B Macelwane was appointed dean of the graduate school to take the place of Dr Schwitalla.

DR HUBERT H RACE, secretary of the Ithaca section of the American Institute of Electrical Engineers, has been appointed assistant professor of electrical engineering at Cornell University

THE *Journal* of the American Medical Association states that Dr Langley Porter, recently appointed dean of the University of California Medical School, has also been appointed professor of medicine and Dr Lionel S Schmitt, who has been the acting dean for several years, has been appointed associate dean and associate professor of administrative medicine, effective November 1 Dr Schmitt, who is also a director of hospitals, was formerly clinical professor of dermatology

DR DONALD H ANDREWS has been appointed assistant professor of chemistry at the Johns Hopkins University

DR T M MACROBERT, of the University of Glasgow, has been promoted to a professorship of mathematics.

M BACHELIER, of the University of Rennes, has been appointed professor of the differential and integral calculus at the University of Besançon

PROFESSOR H LEO has been nominated professor of pharmacology at Bonn

DISCUSSION AND CORRESPONDENCE

THE CONTROL OF DIABETES IN SIAM BY THE USE OF SOLANACEOUS PLANTS

IT may be of general interest to the readers of SCIENCE to learn of the existence in Siam of solanaceous plants whose fruit has a marked effect on the sugar content of the urine in diabetes, a disease that is quite prevalent in Siam.

The discovery of the virtue of these plants was made by the late Dr. Yai S Sanitwongse, a graduate of the medical department of the University of Edinburgh, through having a friend, a native doctor, suffering from advanced diabetes, in whom the quantity of sugar excreted fluctuated in a remarkable manner from day to day, at times practically disappearing. By a process of exclusion, it was possible definitely to correlate the decrease of sugar with the ingestion of small fruits, taken with meals as a condiment Later, the fruits were administered with the food in a number of cases of diabetes, always with marked effect, the sugar clearing up immediately and remaining absent from about twenty hours, but recurring unless the fruits were again taken The daily use of the fruits in very small quantity at each meal kept the sugar in abeyance and led to improvement in the general condition of the patients, without any restriction in the diet, which always comprised a large proportion of rice Special reference may be made to a striking case that has come to the writer's personal notice, that of a male European, about fifty-five years old, who had lived in Siam many years and developed diabetes in very severe form, with the usual loss of weight that proceeded to extreme emaciation This man was induced to make a thorough trial of the solanaceous fruits Beneficial results were noted immediately, so that in six months after he began treatment, and without the use of any other antidiabetics nor any systematic regulation of diet, his physical condition was vastly improved, the sugar was being kept entirely in abeyance, and he added thirty pounds to his weight During that period he had taken at each meal ten of the little fresh fruits, and found that it was not necessary to increase the number, and in all probability that it might even have been feasible to reduce the quantity. The fruits produced no unpleasant gastric or intestinal symptoms. In December, 1925, the use of the fruits had been discontinued for about a year, and the health of the individual remained excellent He then reported that sugar was usually entirely absent from the urine, and that it temporarily recurred only after some dietetic indiscretion, such as a very heavy meal of starchy or sugary food In March, 1927, the general physical condition of the man continued to be good, there was no recurrence of the disease, and he had the satisfaction of feeling that should the diabetic symptoms reappear he had at hand a certain means of combating them.

The plants whose fruits have the noteworthy property indicated belong in the genus Solanum, but do not appear to have been positively identified as to species. There are at least two distinct forms, found wild over a large part of Siam. The fruits, which grow in loose clusters and resemble miniature tomatoes, are about the size of large peas or small grapes, and have a bright green color when immature, becoming yellow or orange when ripe. The taste is not unpleasant. The fresh fruits are said to be more potent, but the dried ones, even after some months, also produce a noticeable effect.

The news of the efficacy of these fruits in diabetes

has become known to the country people in several parts of Siam, and it is reported that sufferers from the disease are now using them with success, without any medical attention or advice. It is even stated that in several districts where diabetes is common the people are employing the fruits as a preventive! In the markets of Bangkok and other communities these fruits are now regularly exposed for sale as food by the small vendors of miscellaneous forest and jungle produce, and enough for five days' treatment may usually be obtained for the equivalent of five cents in United States money.

In the absence of full physiological and clinical data, it would be unwise to set up large claims regarding the therapeutic value of the plants in question, but from the information at hand it would appear that in these plants we have available a cheap, easily administered substance which has a noteworthy palliative influence on the sugar content of the urine in diabetes and may act like insulin There is, furthermore, some evidence that under special conditions the effects may be regarded as curative

It is believed that the known facts are so suggestive as to warrant a thorough investigation, and it is hoped that some workers or institutions in America or elsewhere may feel disposed to conduct a convincing test. Supplies of the fruits may undoubtedly be obtained through various agencies in Siam, such as the American Consulate, the Botanical Department of the Ministry of Commerce, and the Department of Public Health of the Ministry of the Interior, all in Bangkok The plants are so hardy that they could probably be grown from seeds in subtropical parts of the United States, or in hot-houses anywhere.

HUGH M. SMITH

BANGKOK, SIAM

E.M.F. INDUCED IN A STRAIGHT WIRE BY A CURRENT IN A PARALLEL STRAIGHT CONDUCTOR

THE seeming paradox described by Professor Karapetoff, in the article under the above title, in SCIENCE of November 18, arises in its faulty premises.

The conception of current in a long straight conductor with open ends is not permissible. It would require an infinite electromotive force to set up such a current, but more important for the discussion, assuming the presence of the current, a finite change in its value is impossible, for such change would be accompanied by self-induced e m.f. of infinite value, which is absurd. A long straight current-carrying conductor therefore must be part of a closed circuit In such case, the central conductor must either be closed also, or stuck through holes in the outer conductor, or be of shorter length, terminating inside the outer conductor. In any one of these cases e.m.f. will be induced In the last case of the open wire, the e m.f. could not be measured; first, because the necessary instrument could not be connected, and second, because the e m.f. would be too small to measure, the greater part of the total induced e m.f being consumed in the dielectric circuit closing the two ends of the wire.

The reasoning in the second case leads to the correct conclusion as regards such long straight conductors as arise in experience, but by means of unfortunate, and, I believe, unwarranted premises Induced electromotive forces in both experiment and theory arise only from changes in the interlinkages of electric and magnetic circuits. The experimental fact needs no comment as clearly set forth by Professor Karapetoff. The theoretical origin of induced e m.f arises from the energy associated in the combination of a magnetic shell, or an electric circuit, with an external magnetic field, any change therein being reflected as an induced e.m.f in the circuit, as shown in Neumann's expression There is thus no warrant for the use of the idea of collapsing lines of force, or a conductor's cutting lines of force, except in so far as these offer convenient ways of computing changes in the total flux interlinking the electric circuit, which perhaps is only another way of expressing the conclusion reached by Prof Karapetoff in his final paragraph

J B. WHITEHEAD

THE JOHNS HOPKINS UNIVERSITY

IN a recent number of SCIENCE Professor Karapetoff proposes the problem of finding the induced electromotive force in a straight wire due to variation of the current in a surrounding coaxial hollow cylinder. He presents two lines of argument which lead to different results, but recognizes that both methods of reasoning are open to objection, in that they are based on Faraday's circuital relation which is valid only for a closed circuit. His inference that it is not legitimate to speak of an electromotive force in a single straight wire does not, however, carry conviction to the present writer. For suppose the long hollow cylinder to be charged initially, positively at the upper end and negatively at the lower end. These charges, oscillating up and down, constitute a varying current, and if there is an axial electric intensity an oscillatory current will be induced in the central wire, whose presence can be detected by the heating produced without the necessity of attaching voltmeter leads to the ends of the wire.

The induced electromotive force in a secondary circuit fixed relative to the observer's inertial frame produced by a varying current in a fixed primary is

due to the portion of the electric field of the charges constituting the current which depends upon their acceleration. In the case of the open circuit under discussion the electromotive force along the central wire can not be calculated in any simple manner from Faraday's law, but it can be obtained at once from the series for the simultaneous electric field of a point charge given on page 40 of the writer's "Introduction to Electrodynamics" The necessary integration can be carried out without difficulty if we assume that the inner wire has a length small compared to that of the outer cylinder and is placed at the center of the latter. In this case the electric intensity along the axis is found to be

$$E = -\left\{ \log \frac{1+\cos\theta}{1-\cos\theta} - \cos\theta \right\} \frac{di}{dt}$$

where both E and i are expressed in electromagnetic units and θ is half the angle subtended at the center of the tube by a diameter at either end The current has been assumed to be uniform along the length of the tube, which would not be the case in the illustration previously mentioned The electromotive force along the inner wire is obtained by multiplying this expression by the length of the wire. As the length of the outer conductor is increased $\cos\theta$ approaches unity and E becomes great without limit

The electromotive force is the same as if the current were concentrated in a generating line of the hollow cylinder instead of being spread over its surface Therefore we can check the formula given above by considering the former inner conductor to be one side of a rectangular circuit lying in the plane of the two conductors just considered and extending to infinity on the side away from the generating line If we calculate the electromotive force along the long sides of the rectangle by the method employed above we get an expression per unit width of the circuit equal to the second term in the formula above, but opposite in sign. As the electromotive force in the distant short side of the rectangle is negligible, the total electromotive force around the entire circuit is given by the first term of the formula, for a rectangle of unit width. But if we calculate the magnetic flux through the rectangle and then compute the electromotive force from Faraday's law we are led to the same expression.

LEIGH PAGE

SLOANE PHYSICS LABORATORY,
YALE UNIVERSITY

SIR JAGADIS CHUNDER BOSE AND HIS LATEST BOOK

THE delicacy of the political situation in India, the prominence of the Bose family, the unusual taste for biology possessed by one of its members, the strain of mysticism in the minds of all the East Indians with whom we come into contact—these factors and their sequelae have produced a singular situation in the scientific world. As a result biologists, or at least botanists, may be divided, without serum-diagnosis, as Bosephile or Bosephobe. and to have a neutral reaction is taken to indicate either a degree of ignorance or a feebleness of backbone quite deplorable

In the first place, there is no question that Sir Jagadis Chunder Bose is the most distinguished biologist in India The wealth of his family has secured for him freedom from economic anxiety, has built and supported for him the Bose Institute in Calcutta, where, under his directorship, the study of reactions to stimuli in the living and the lifeless is carried on in accordance with his tastes and methods

Bose's recent book, "Plant Autographs and their Revelations," is the address of an enthusiast to an audience conscious of ignorance and desirous of enlightenment. From its dedication to his wife, "who has stood by me in all my struggles," to the last paragraph, "Not in matter but in thought, not in possession nor even in attainments, but in ideals, is to be found the seat of immortality," one sees the idealist, the mystic, dealing with facts too few in number, too incompletely understood, too imperfectly apprehended in their relations, quite too inaccurately measured and recorded, to justify conclusions put forward as knowledge. The conclusions are interesting, suggestive though not new, and are entirely legitimate if correctly labeled but they are not science, they are not knowledge, they are belief, they are a philosophy of life, a guide and interpretation of conduct.

The trouble with Bose, as I see it with my occidental eyes and my American mind, is that while his curiosity is directed to biological phenomena, his mind is inadequately equipped with the information and the habits necessary for accurate study, and his reflections are addressed to philosophical problems He is practical minded to the extent of using self-recording apparatus in his laboratory and social institutions in his human relations, but his ambitions exceed his capacities, his critical faculties are not applied to his methods and their results, his vocabulary outruns his findings. This may be illustrated by a quotation, typical of the whole book in spirit and defects: pp. 183–185. "Autographic Record of Assimilation:" "Water plants obtain their carbon from the carbonic acid dissolved in water. When sunlight falls upon these plants, carbonic gas is broken up, the carbon becomes fixed in the form of organic compounds known as carbohydrates, and an equal volume of oxygen is evolved which rises as a stream of bubbles from

the plant. The rate of evolution of oxygen indicates the rate of assimilation Numerous difficulties were encountered in making this method practical, they have been overcome by my automatic recorder A piece of a water plant, *e g*, *Hydrilla verticillata*, is placed in a bottle completely filled with tank-water containing sufficient CO_2 in solution, the open end of which is closed by a special bubbling-apparatus, the bubbler, for measuring the oxygen evolved The bubbler consists of a U-tube, the further end of which is closed by a drop of mercury acting as a valve The oxygen evolved by the plant, entering the U-tube, produces an increasing pressure, which eventually lifts the mercury valve and allows the escape of a bubble of gas The valve then immediately closes until it is lifted once more for the escape of another equal volume of gas The movement of the mercury completes an electrical circuit, which either rings a bell or makes an electro-magnetic writer inscribe successive dots on a revolving drum (fig 102) The automatic method eliminates all personal errors of observation, it is so extremely sensitive that it is possible to measure a deposit of carbohydrate as minute as a millionth of a gram. In illustration of the practical working of the apparatus I will give the following example The plant with the apparatus is so placed as to face the northern light, the bell rings each time it has evolved a certain amount of oxygen representing an equal volume of absorbed CO_2 If a person now stands obstructing the light, the assimilation is slowed down and the bell now strikes at longer intervals When strong sunlight is thrown on the plant, the successive strokes on the bell become greatly quickened The plant is such a sensitive detector of light that it may be employed as a photometer for indicating the slightest variations in the intensity of the light of the sky"

I need not point out to the initiated the many individual faults, even errors, in this plausible and very interesting exposition, but certain comments may be made by the way 1 Whatever may be the usage in India, or elsewhere in the English-speaking world, discussion has demonstrated that *carbon fixation* is a better term than *assimilation*, and that *photosynthesis* is still better because self-descriptive. 2 Water plants probably obtain as much carbon from carbonates and bicarbonates, where they are present, as from carbon dioxide which, in solution in water, may be *called* "carbonic acid" 3 "When sunlight falls upon these plants" much more happens than merely that "carbonic acid is broken up," for—to mention only one thing—the temperature rises, producing purely physical effects in the water, in the plant cells and tissues, and bubbles arise which are not wholly, and may not be even mainly, oxygen. Hence any apparatus devised to demonstrate photosynthesis and depending upon evolution of gas in water of unknown composition, of undetermined temperature, in unmeasured light, should be used for demonstration, graphic representation, but never for one moment considered as *measuring* "a deposit of carbohydrate." This has been recognized for so long in botanical laboratories in this country that the method is employed only on the lecture table, or in elementary laboratory experimentation

I do not need to multiply quotations "Resonant recorder," "acuity of perception," "the plant biophytum is found to be eight times more sensitive than a European and four times more so than a Hindu"—these also are fair samples of vocabulary, of deduction, and of aviation It is a book as dangerous as it is fascinating Would that it might be followed by a book of equal charm, but exhibiting the respect for the truth which keeps the occidental scientific man from mixing poetry, mysticism and grandiose generalization with his descriptions of the facts of nature! Nature is indeed more wonderful, more beautiful, more impressive than the products of man's imaginings, reflections and theorizings

George J Peirce

Stanford University

WHEN IS MID-WINTER?

I have long intended to answer the communication by Charles H Briggs in Science for April 29, regarding the date of midwinter, but have delayed until I could speak from observational data I have never before heard the shortest day called the middle of winter One should hardly expect the coldest weather to fall then, for though it is the day when the hemisphere receives least sunshine, yet the general run of weather should continue to grow colder so long as the solar energy received per day is insufficient to replace the heat radiated to space For this reason the curve of temperature shows a lag in phase as against that of sunshine.

Our texts of descriptive astronomy and most almanacs tacitly accept the amount of this lag as a month and a half, making the four seasons coextensive with the four quadrants of the sun's apparent motion, thus calling the shortest day the *beginning* of winter. This is an easy way of defining the seasons and one entirely independent of local conditions. Perhaps this last fact is one cause of its apparently wide acceptance.

In addition to the astronomical definition, Webster and other lexicographers give as the "popular" definition of the seasons, groups of three months each, beginning (for the U. S A.) on March 1, June 1, September 1 and December 1, thereby antedating the astronomical seasons by three weeks. This has the

Station	Latitude	Longitude	Year's Record	Mean °C	Annual Range °C.	Midsummer	Mid-winter
Estación Misionera	−28° 28′	+58° 25′	4½	24 6	10 1	Jan 20	July 1
Asunción	25 18	57 40	7	22 8	11 2	" 13	June 30
Salta	24 46	65 24	16	17 4	7 4	" 10	" 30
Tucumán	26 50	65 12	7	18 7	13 2	" 9	" 30
Andalgalá	27 30	66 26	5	19 4	16 1	" 9	July 3
Córdoba	31 25	64 12	20	16 8	13 9	" 14	" 2
Rosario	32 56	60 39	11	17 7	15 0	" 18	" 5
La Plata	34 55	57 56	18½	16 3	14 3	" 21	" 15
Chos Malal	37 27	69 50	4½	14 1	16 1	" 18	" 9
Colonia 16 Octubre	43 5	71 20	5	9 6	15 0	" 22	" 9
Isla de los Estados	54 23	63 47	7	5 7	6 4	" 24	" 22
Isla Laurie	−60 43	+44 47	8	−4 4	1 21	" 6	" 14

qualities of simplicity and independence of local conditions just as fully as the other, and is more convenient for tabular work Just how popular and widely accepted it is I do not know. The Oficina Meteorológica Argentina uses it, transposed, of course, in all their summaries, but I must confess that I had not heard of this definition till I had occasion to look into their work

A rational definition of the seasons should be based on the characteristics of the annual temperature curve. This will perforce introduce the local element, but that is not necessarily disadvantageous Mr Briggs defines midwinter in a way which seems logically sound and quite acceptable, though the 60° F is perhaps a bit arbitrary That his date of midwinter and half the coal supply does not agree with the proverb he cites vitiates neither, for the proverb refers to hay, which with other crops does not become available immediately the cold weather is over, but later in the growing season. Half the store of these should consequently remain some time after midwinter

Partly to furnish Mr. Briggs data from South America for comparison and partly to clarify my own ideas on the matter, I have summarized the La Plata temperature record[1] and have selected several other stations of wide geographical distribution from among the many discussed in the Anales de la Oficina Meteorológica Argentina. Since some stations have their annual range entirely above and another entirely below the 60° F. used by Mr. Briggs, a departure from his procedure was necessary. I have used as base line the general mean of the station and have defined midsummer and midwinter as the dates whose ordinates bisect the areas between the mean temperature and the observed temperature above it and below it, respectively

From the table it will be seen that midsummer in Argentina, as determined, agrees closely with midwinter in the Twin Cities as defined by Mr Briggs. On the other hand, our midwinter is appreciably earlier than the date he deduces for midsummer. There is also an indication of later dates for midwinter as one moves southward while the date of midsummer varies less uniformly and by a less amount.

I remember well the resentment felt as a boy when, on the occasion of a cold snap a week or so before Christmas, one of my elders remarked that winter had not yet begun Perhaps this started vaguely the idea which has since become a conviction, that in the astronomical definition of the seasons the lag is grossly overestimated In order to determine its true amount I have considered a tentative definition of the seasons on the basis of the temperature curve as follows:

That part of the curve of annual variation of temperature containing the maximum (minimum) and subtended by a horizontal chord 91 days in length is to be considered summer (winter), the intervening ascending (descending) portion is to be considered spring (autumn)

Selecting from among the dozen stations used above those five with the longest series and applying this tentative definition to the smoothed ($9c' = a + 2b + 3c + 2d + e$) decade temperatures, I obtain as the first days of summer and winter the dates given below.

Station	Beginning of Winter	Beginning of Summer
Salta	May 17	Nov 15
Córdoba	May 16	Nov. 30
Rosario	May 21	Dec. 2
La Plata	May 27	Dec. 6
Isla Laurie	May 29	Dec. 19

The progression of summer with latitude is remarkably strong. That of winter is less, but still well marked and in the same direction. Comparing these dates with those of the astronomical definition one sees that only summer at Isla Laurie agrees even

[1] The readings at 7 A. M., 2 P M. and 9 P M. over ten (eleven) day intervals were averaged and then the corresponding decades of each year combined.

approximately Other dates for summer are from two to five weeks earlier and the dates for winter from three to five weeks earlier Consequently the "popular" definition represents the facts for this Republic for better, and even that overestimates the lag for the northern provinces

BERNHARD H DAWSON

LA PLATA,
ARGENTINA

QUOTATIONS

INTERNATIONAL CONGRESSES

AMONG the many things of value lost through the world war was that informal yet efficient organization known as the International Congress of Applied Chemistry, which was responsible for holding once in three years a scientific conclave, truly international in its attendance, work and publications Four languages were official—French, Italian, German and English. Representatives on an equal footing came from everywhere and were welcome Latest accounts of scientific progress furnished the keynote

How well we remember the last of these international congresses in 1912! There was the gathering in Washington in Continental Hall, where the leader of each national delegation spoke following the playing of his national anthem by the Marine Band There was a notable afternoon with the President of the United States, the reception, the half-day of sight-seeing and then the special trains to New York where the work of the congress was conducted

Columbia University and the College of the City of New York fairly swarmed with hundreds of chemists The meetings, held on the sectional plan according to subject, were open to all and at stated times the congress gathered to hear the principal addresses delivered by representatives of the leading foreign countries. Here we heard the glowing account of the development of the arc process in Norway by Eyde himself Bernthsen demonstrated that nitrogen and hydrogen could be compelled to combine to form ammonia. Perkin discoursed on synthetic rubber, and the address of Ciamician on photochemistry remains a classic No one who saw the multitude of products of industrial chemistry which Duisberg brought from Germany will ever forget that occasion in the great hall at City College Of course there were banquets, sight-seeing, garden parties and receptions, but they were incidental The congress did real work, as the twenty-nine volumes now on our shelves amply testify

The International Congress was able to function without a continuous organization and without a paid secretariat and headquarters subject to national influences The congress decided where its next meeting would be held, selected the man to be responsible at that place and left it to him to form his own organization, work out the details and proceed. The war spoiled the congress planned for 1915, which was to have been in Russia, under the chairmanship of Dr Walden, the eminent scientist who is the visiting lecturer at Cornell this semester

It is history that the war gave rise to scientific organizations in several countries, and it is but natural that these should have been the ones to form a new international organization. With the effect of the war still upon them, conditions were at first imposed which prevented the adherence of the former enemy countries to the new union, but fortunately those difficulties have been remedied and any country, the science of which can be represented through a central national body, is welcome.

At first the principal business of the International Union of Pure and Applied Chemistry, which is sponsored by the International Research Council, was the creation of good will and better understandings and beginning anew the promotion of scientific work on a true international basis Although some committees for scientific work have been formed, it is patent that the union has added little, if anything, to the sum total of scientific knowledge and has devoted itself more to questions of policy and diplomacy through social activities This has been going on for eight years, but for the last year or two the active members of the union have come to realize that if it is to survive and perform a useful function its program must be changed.

The union is too much restricted in membership and in the number of individuals involved to accomplish its own ends At present it brings together far too few really to hasten the day of better international relationships If augmented in numbers it meets too often, and at the basis of it all is the neglect of its real opportunity again to make available the advantages of the world international congress. It is conceivable that some of the work of the union would require the meeting of a small group more frequently than once in three years, provided the union can be looked upon as a sort of nucleus or holding organization to which is entrusted the promotion of chemistry, international so far as the science is concerned. This involves assuming responsibility for a scientific congress to be held very much along the lines of the old international congress.

This subject from time to time has been forcefully brought to the attention of the officials of the union and was discussed at the Washington meeting when Ernst Cohen, the president, stressed the importance of organizing a truly international congress of chemistry along democratic lines. At the recent meeting in Warsaw articles providing for such congresses were pre-

sented and incorporated into new statutes of the union These articles were passed unanimously, but according to the union's rules must be held over until the next meeting, scheduled to take place in Holland in July, 1928 In order to avoid undue delay a committee has been set up charged with the formulation of detailed plans for such international congresses. It is expected, therefore, that with the adoption of the new statutes the union will be in position to act upon the report of the committee It seems unfortunate that there should be even a year's delay for many are becoming impatient, and it is already fifteen years since the chemists of the world have gathered together in a congress organized along democratic lines and devoted to science.

We hope that the International Union of Pure and Applied Chemistry will take leadership in this matter and make the most of its opportunities It would be unfortunate should it be found necessary to set up any other organization — *Industrial and Engineering Chemistry*

SCIENTIFIC BOOKS

Handbook of the Echinoderms of the British Isles By TH MORTENSEN 471 pages, with 269 text-figures. Humphrey Milford, Oxford University Press, 1927.

IT is indeed gratifying that the Oxford Press should consider it possible to undertake the publication and general distribution of a large book dealing with a group as little known to the public as are echinoderms. The paper, printing, illustrations and binding are what we have learned to expect from the Oxford Press and are all that could be desired for such a volume As the author occupies a preeminent position as a student of echinoderms, it is not strange that this handbook is by far the best general account of the group that has ever appeared. Taken as a whole, and considering the purpose in view, the volume is beyond praise. It is attractive in appearance, natural and thoroughly usable in arrangement, reliable in content and exhaustively complete for the area included. The number and quality of the illustrations are notable and enormously enhance the value of the book. Of course, there are some errors of both omission and commission, but they are chiefly of a trivial character or involve matters where there is room for difference of opinion. One detail that invites criticism is the use of capitals for specific names, derived from personal names. This is usual among botanists, but most zoologists long since abandoned it. Dr. Mortensen has, however, clung to botanical custom.

In an interesting preface Dr Mortensen explains the inception of the book and the reasons for including under the term British Isles an area vastly more extensive than the term usually connotes. The whole Northeastern Atlantic Ocean from Iceland to the Cape Verde Islands is included within the scope of the book so far as the deep water forms are concerned, of course, only those littoral forms are included which are known from the British Isles themselves or may reasonably be expected to occur there. Hence the book will be of service not only in Great Britain but in most parts of Western Europe and, in connection with deep sea work, far to the north, west and south of the British Isles.

The book opens with an admirable general account of echinoderms, covering in a few pages the main features of the structure, development, larval forms and distribution of the group and concluding with a key to the five well-marked classes of Recent forms. Similar treatment of each of these five classes makes up the remainder of the book, some 30 pages being given to the crinoids, 103 to the asteroids, 109 to the ophiurans, 96 to the echini and 88 to the holothurians

The section dealing with the crinoids, or sea-lilies, treats of a dozen species, actually known from the area under consideration, each of which is figured either wholly or as regards essential parts The artificial keys, however, include no fewer than 24 species of 20 genera, distributed in 8 families, these additional forms are those which may be expected to occur in the region The treatment of the crinoids is notable for its freedom from unnecessary technicalities and details, while at the same time it is thoroughly modern and includes the latest available information about these relatively rare animals.

The use of the term sea-star, instead of starfish, is the first thing that catches the eye in the section dealing with the asteroids This is a natural and sensible change and it is to be hoped that all zoologists will note and adopt it; perhaps it is too much to hope that the inaccurate term "starfish" will disappear at once from literature, but let us hope its days are numbered. The classification of the sea-stars is still in a state of flux, certain of the recognized families and orders being well-defined natural groups, while others are unsatisfactory and artificial. Dr. Mortensen has adopted as simple and usable a system as the complexity of the problem permits, recognizing 3 orders, represented in the British area by 20 families. There are 67 genera and 114 species represented in the numerous and very valuable keys, but only 47 of the species are actually known from the region concerned. Of these, 43 are well figured,

and there are additional figures showing structural details. It is a very striking indication of the modern tendency towards small genera that the 47 species are placed in 39 genera, one genus (Solaster) has 3 species (but 1 of these is usually considered generically distinct!) and half a dozen genera have 2 representatives each—the remaining 32 genera have in the British area but 1 species each so far as at present known

In dealing with the brittle-stars, Dr Mortensen is again faced with the problem of an unsatisfactory classification, and, in the opinion of the present writer, treats it in an unsatisfactory way In rejecting Matsumoto's classification, Dr Mortensen returns to the old arrangement of the ophiurans in two orders, a distinctly backward step and quite unnecessary There is no need of rejecting all of Matsumoto's work, much of it of very great value, merely because his first order, the Phrynophiurida[1] seems to be an unnatural assemblage Probably we shall have to recognize 5, and possibly 6, orders, when we more perfectly understand the problem and have the necessary data Mortensen finds it more difficult to make a satisfactory key to the 11 families of British (or potentially British) ophiurans, which he puts in the old heterogeneous order Ophiurae, than he does in the case of any other group, but he succeeds admirably in spite of the inherent obstacles No fewer than 141 species of ophiurans, grouped in 48 genera, are indicated as potentially British but only 50 species are actually known from the area, as yet, and of these only about a dozen are found in shallow water The bulk of this section of the book therefore, deals with forms, the average zoologist, even though a frequenter of marine laboratories, is never likely to see Particular attention is paid to the larval forms and a key to the known larvae of British species is interesting and of real value The discussion of the ecology of brittle-stars and of their parasites is particularly good

In the handling of the echini, Dr. Mortensen is dealing with the group of which he is preeminently the master and this section is therefore, of great interest The account of the morphology is clearly written and on the whole satisfactory, but in discussing the "lantern," the perignathic girdle of the test, with which it is intimately associated, is slighted and the important distinction between auricles and apophyses is ignored No reference is made to the absence of the "compasses" in the "lantern" of clypeastroids. There is a little confusion about the use of the term "irregular echini" for while in the key to orders, the "Irregularia" are made to include the clypeastroids, elsewhere statements are made which indicate that Dr. Mortensen had the spatangoids only in mind Thus (p 262) the posterior gonad is said to have disappeared in the "irregular echinoids" whereas it is present in a large number of clypeastroids The paragraphs concerning the larval forms and the key to those known from British seas are particularly important and useful The classification used is open to little criticism and has the great merit of being simple and yet adequate There are 33 genera and 53 species included in the keys but only 21 genera and 33 species are actually known from Great Britain The illustrations in this section of the book are worthy of special praise An interesting side-light on Dr Mortensen's attitude towards rules of nomenclature is shown by a footnote on p 321, in which he objects to quoting the name of the first *describer* of *Aëropsis rostrata* as authority for the species because it will deprive another more eminent authority of "the honour"!

The introductory pages to the section on holothurians are particularly good reading and give a very clear account of the class. The classification used includes results from some very recent researches and the keys are as good as can be prepared for a group so difficult of satisfactory preservation The assistance of Dr. Elizabeth Deichmann in the preparation of many of these keys is cordially acknowledged Some 44 genera and 116 species are regarded as potentially British but only 14 genera and 30 species are actually known as yet from the area, so that here as among the ophiurans, the book deals with a preponderance of forms which the average zoologist, even though he live at a marine laboratory, will never see This is of course not a defect, it simply emphasizes the extraordinary scope of the book Naturally the illustrations of holothurians are not as numerous or attractive as those in the other classes, but they are well-chosen and satisfactory.

The book concludes with a brief appendix, 8 pages of bibliography, a list of abbreviations used for authors' names, and no fewer than 5 admirable and very useful indexes It is difficult to conceive of more satisfactory indexing From any point of view the volume is a credit to those responsible for it and the Oxford Press, Professor J. Stanley Gardiner, who induced Dr. Mortensen to undertake the work, and the author himself are to be heartily congratulated. It unquestionably adds new honors and prestige to the record of the eminent Danish zoologist.

HUBERT LYMAN CLARK
MUSEUM OF COMPARATIVE ZOÖLOGY,
HARVARD UNIVERSITY

[1] Dr. Mortensen wrongly calls it Phrynophiurae and uses the same erroneous termination for the other three orders.

IONIZATION BY POSITIVE IONS

THE question as to whether positive ions can ionize atoms has been the subject of much controversy. Experimentally no direct evidence exists which will enable one to decide between the two apparently opposing views held If one regards the phenomenon from the point of view of the ionization of an atom by a moving charged particle in virtue of the action of the charge on the electron of the neutral atom, one must agree with J J. Thomson[1] that it is unlikely that on this mechanism ions with less than a few thousand volts equivalent of energy can ionize. On the other hand, as J Franck[2] points out, and as is indicated by certain phenomena in ionization by slow canal rays, in the discharge of electricity from positively charged points, and from the temperature ionization observed by King,[3] and also by Noyes and Wilson,[4] we have definite evidence of the ionization of gases by impact between charged or uncharged atomic masses moving with velocities corresponding to only two or three times the ionizing energy These two apparently contradictory[5,1,2] views, together with the conflicting experimental evidence put forward in an attempt to decide the question, have led to a good deal of confusion In part this has been clarified by Joos and Kulenkampff[3p] but not completely In a seminar course the writer recently had the opportunity of reviewing the literature on the subject and with the benefit of the criticisms of his two colleagues, Professor R B. Brode and Dr Arthur von Hippel, believes that he has been able to clarify the situation still more and that he has been able to show that there is no real contradiction in the two views.

It is the purpose of this article to briefly set forth these conclusions. To do this we may regard three distinct processes. They are

1 The ionization by *rapidly* moving *charged* particles, *e g.*, electrons, protons, and doubly charged He atoms *

2 The ionization of molecules of a gas of lower or equal ionizing potential by ionized atoms or molecules which may be in motion or at rest (*e g*, an exchange of charge).

3 The ionization resulting from the impact of atoms or molecules, charged or neutral, which possess electrons and which have an energy which is a small multiple of the ionizing energy of one of the atoms.

1 The first class of ionizing processes is characterized and governed by the classical laws of electrodynamics and the laws of momentum and energy[6,7] with the limitation that energy transfer to an electron of an atom acted on must follow the quantum conditions, [8 9 10] (*i e*, energy can only be absorbed if the electron in question receives a quantum of energy demanded by its change in status) The applications of these laws to the fast electron, the proton and the alpha particle, have been adequately proven by the agreement in order of magnitude between the predicted results and observations That is, the ionization by electrons (Whiddington's[7,11] law and possibly even the application to ionization for slower electrons, though the latter is more doubtful), by protons[12] and by α particles as calculated by Henderson,[8] Fowler,[9] Bohr[7] and others, agrees within a factor of two or three with the observations These laws, as Thomson[1] points out, demand that ionization by such particles in virtue of the action of the charge ceases at velocities easily computed from laws of momentum and energy, corresponding to values of the order $5\times10^7-1\times10^8$ cm/sec Such velocities correspond to energies of the order of the ionizing potentials for atoms in the case of electrons, to energies of the order of 2,000–3,000 volts for protons, and to energies of the order of 10,000 volts for alpha particles. The efficiency of this type of ionizing action is very high and is more or less successfully predicted from classical theory, assuming the ionization potentials as observed to be correct [7 8 9,10] The conclusions are substantiated by the sudden cessation of ionization by α particles and protons[13] at the end of their range observed, and by the recent work of Dempster[14,5] on the long free paths of protons of 900 volts velocity. It is the only process by which such single charges can produce ionization.

2 The second class of phenomena belong, properly speaking, in that class of phenomena called "inelastic

1 Thomson, J. J, *Phil. Mag* 48, 1, 1924, and also 23, 454, 1912.

2 Franck, J, *Zeits. f. Phys.* 25, 312, 1924; *Handbuch der Physik* Vol. 23, p. 731.

3 King, A. S., *Astrophys J.* 48, 13, 1918, and many other papers in this journal.

4 Noyes and Wilson, *Astrophys. J* 57, 20, 1923.

5 Rüchardt, E., *Handbuch der Physik*, Vol. 24, p 99.

* Singly charged He atoms and all *rapidly* moving charged particles should be included here. As, however, these carriers also can act to ionize in other ways which confuse the issue, and in order to emphasize the mechanism of the process, these have been purposely left out as typical examples of this class.

6 Thomson, J. J, *Phil. Mag* 23, 449, 1912, "Conduction of Electricity through Gases," pp 370–382

7 Bohr, N, *Phil. Mag* 25, 10, 1913, and also 30, 581, 1915

8 Henderson, G. A, *Phil. Mag* 44, 680, 1922.

9 Fowler, R. H, Proc Camb Phil Soc 21, 521, 1923.

10 Loeb and Condon, *Jr. Frank. Inst.* 200, 595, 1925.

11 Whiddington, R., Proc Roy. Soc. 85A, 323, 1911; also 86A, 360, 1912.

12 Dempster, A. J., *Phys. Rev.* 8, 656, 1916.

13 Baerwald, H, *Ann. der Phys* 65, 167, 1921.

14 Dempster, A. J., Proc. Nat. Acad. Sci. 11, 552, 1925; also 12, 96, 1926; *Phil. Mag.* 3, 115, 1927.

impacts of the second class," first discovered experimentally by Franck[15] and Cario, and later observed directly by Erikson[16] and Harnwell.[17]

They explain many of the phenomena observed by Dempster[12] on canal rays of low velocity They occur fairly readily, and are largely independent of the velocity of the carrier. It is, however, possible that through the third class of ionizing phenomena the energy of motion could be utilized to make this group include ionization by moving ions of appropriate velocity of molecules of higher ionizing potential. To date, however, no certain evidence exists for this extension, though from indirect observation it seems probable This process obviously can not lead to the production of a very much larger number of charged carriers than the initial number of charged carriers. Thus in a great many problems of ionization by means of charged particles their importance is secondary

3 The third class of processes are definitely established by the existence of temperature ionization observed by King[3] and treated theoretically exhaustively by Eggert,[18] by Saha,[19] and Fowler [20] Even if some of the assumed quantities (*e g*, the energies of the atoms necessary for ionization in such a process) in the equations turn out to be in error by a factor of two or three, the correctness of the deduction is unquestioned As regards other evidence for ionization of gas molecules by positive ions, or moving neutral molecules of relatively low velocities, the evidence is less clear if one exclude occurrences of the type of Class 2 above [12] The evidence from direct measurement on positive rays has been seriously questioned by Horton and Davies[21] and by Hooper,[22] due to the fact that secondary emission of electrons from the walls through the positive ion bombardment and photoelectric phenomena were not rigorously excluded. The work of Baerwald and others[23] on emission of secondary electrons from metals by positive ion bombardment upholds this Hooper concludes that if ionization of a gas by positive ions below 1,000 volts occurs, the process is very inefficient. He believes that at high pressures (where many collisions can take place and the ionization could be observed for inefficient agencies) there is some evidence that it occurs in his experiments The evidence from the experiments on ionization phenomena in gases and sparking potentials in fairly uniform fields, as interpreted by Townsend,[24] has recently been seriously called into question[25,26] on the basis of the probable actions of positive ions or radiation on the cathode. Townsend[27] himself agrees that such processes would fit his equations as well as experimental uncertainty admits. He however points out that only by assuming ionization by positive ions of low velocity in a gas can we explain the discharge from positive points at high potentials [28,29] In this assertion he is undoubtedly correct if we add the possibility that such ionization may be in part indirect as later described. There is thus evidence that neutral atoms, molecules, canal rays, and *slowly* moving positive rays directly or indirectly can ionize gas molecules by impact, though the efficiency of the process is obviously very low. This type of activity is, however, essentially different from that under Class 1 in *that it is independent of the charged state of the ionizing atom or molecule, so that the charge is but incidental to the mechanism* The process, however, depends on one additional feature *Every atom ionizing in this fashion must have at least one electron in an orbit about it, and possibly more.*

It is in fact the presence of the electrons in these ionizing systems that enables them to produce ionization independently of charge, and thus give a mechanism which can be clearly differentiated from the first class of ionization. With electrons in each of the atoms or systems colliding, transfers of energy between the electrons of the two systems again become possible at low velocities However, it is difficult to postulate the exact mechanism of such transfers, in which the relative energies of two atoms are transferred to one or two of their electrons in a molecular impact. To date the new quantum mechanics has been unable to cope with the problem. The earlier discussions of Franck,[1] and Joos and Kulenkampff[30] treated the atoms as elastic spheres. If one could conceive of the electrons being rigidly held in stationary positions by the binding forces of the nucleus, interactions of the observed sort might be expected. Such an assumption enables one to find a plausible explanation for inefficiency of the process; for it would be a relatively rare atomic encounter that brought two electrons of the colliding atoms into such

15 Franck and Cario, *Zeits für Phys* 11, 3, 1922
16 Erikson, H A, *Phys Rev* 28, 372, 1926
17 Harnwell, G P, *Phys. Rev* 29, 830, 1927.
18 Eggert, J, *Phys Zeits* 20, 570, 1919.
19 Saha, M. N., *Phil. Mag* 40, 478, 1920.
20 Fowler, R. H, *Phil Mag* 45, 1, 1923
21 Horton and Davies, Proc. Roy Soc. 95A, 333, 1919
22 Hooper, W J, *Jr Frank Inst* 201, 311, 1926.
23 Rüchardt, E, *Handbuch der Physik*, Vol. 24, p. 105
24 Townsend, J S., "Electricity in Gases," Chap. IX, p 322.
25 Holst and Oosterhuis, *Phil. Mag*. 46, 1117, 1923.
26 Taylor, James, *Phil. Mag* 3, 753, 1927; also 4, 505, 1927, Proc. Roy. Soc. 114A, 73, 1927.
27 Townsend, J. S., "Electricity in Gases," p. 330.
28 Huxley, H. G L., *Phil. Mag*. 3, 1057, 1927.
29 Townsend, J. S., "Electricity in Gases," p. 371.
30 Joos and Kulenkampff, *Phys. Zeits*. 25, 257, 1924.

a relation that the energy of atomic motion was concentrated on one electron and thus made possible its escape However, the electrons are more probably in orbits in the atoms and the flexibility of this type of binding, coupled with the experimentally observed fact that the orbital momentum of electrons in atoms is not manifested in ionization processes,[31] makes it difficult, if not impossible, to explain the facts in a simple mechanical fashion. We can only conclude that there exists a mechanism in atoms which in *rare collisions by means of the interactions of the electrons in the atoms enables the relative energy of the atoms to be transferred to one of the electrons*

The presence of a positive charge on one of the two colliding atoms at low velocities should affect the ionization by such a mechanism but slightly As Franck[1] has stated it increases the energy necessary to cause ionization, as with the charged atom the electron must escape against an attractive charge of two units instead of one Besides this minor influence the charge plays an important indirect rôle, in low velocity phenomena, in that it enables a molecule or atom to acquire its ionizing energy from an electrical field, an energy which it otherwise would practically never acquire at room temperatures as a result of the heat motions Such an atom or molecule having acquired the energy through its charge is then able to ionize molecules itself, or perhaps is able by impact to impart its energy to a neutral molecule which can ionize slightly more effectively In any case whatever its manner of producing ions, the function of the charge is but indirect enabling the ion *to acquire energy. It has little to do with the subsequent mechanism of removal of electrons* by the ion, thus clearly differentiating its ionizing mechanism from that of swiftly moving charged particles.

It is also conceivable that one ion may ionize by any two or even all three mechanisms simultaneously, although at high speeds the preponderating mechanism for an ion with electrons will be processes of Class 1, while as it slows down the processes of Class 2 and 3 will entirely predominate. At intermediate speeds probably all mechanisms are active and thus lead to some of the apparently contradictory results obtained.

We thus see that in terms of the three different mechanisms, the outstanding conflicting observations can be simply explained and it is seen that there is no essential contradiction even between the extreme views of Thomson and Franck; for we have seen that neither a proton nor a doubly charged helium atom can ionize below certain minimum velocities as classical theory demands that they should not, while hydrogen atoms, singly charged helium atoms and neutral helium atoms can be expected to ionize at low velocities albeit very ineffectively.

[31] Watson, E. C., *Phys. Rev.* 30, 479, 1927.

LEONARD B. LOEB

PHYSICAL LABORATORY,
THE UNIVERSITY OF CALIFORNIA

SPECIAL ARTICLES

CORRELATION BETWEEN ELECTROMOTIVE SERIES AND OXIDATION POTENTIALS AND PLANT AND ANIMAL NUTRITION

In studying the distribution and the dominance of pasture plants, it was observed that there is a definite correlation between the dominance of certain pasture plants and the natural or native vegetation An attempt was made to correlate the growth and dominance of the various plants with the soil acidity, but it was soon found that there is no very close correlation between acidity of the soil and the dominance of certain types of pasture plants.

Since no very definite correlation was found between the acidity of the soil and the growth and dominance of certain plants, an attempt was made to correlate plant growth with plant residues, particularly the basic nitrogenous materials, including ammonia, amines, etc, and here again only a partial correlation was found between the availability of the basic nitrogenous organic residues and plant growth

The nitrogen carbon ratio in the organic residues probably affects the mobility of the nitrogen in the soil There is a difference in the nitrogen carbon ratio in various plant residues The difference in the nitrogen carbon ratio in peat soils illustrates the points in question It has been found that some peat soils have a nitrogen carbon ratio as narrow as 1 · 8, while others have a ratio as wide as 1 70 or wider This difference in nitrogen carbon ratio undoubtedly affects the availability of anionic nitrogen. It has been found that there is a close correlation between the calcium oxide content and the width of the nitrogen carbon ratio in peat soils Where the nitrogen carbon ratio is narrow, it indicates that there is a relatively large amount of high oxidation potential mineral basic material present. And in such a situation it has been found that there is often an accumulation of toxic amounts of nitrates But when the nitrogen carbon ratio is wide it indicates that there is a limited amount of high oxidation potential mineral basic material present. And where such a condition prevails it may result in a prolonged nitrogen starvation period, especially early in the growing season Where the nitrogen carbon ratio is very wide such plants as some of the conifers, poverty grass (*Danthonia spicata*), certain species of Agrostis, etc., which may readily utilize cationic nitrogen, are apt to dominate in nature. Other plants, such as certain species of oak, hickory, poa, etc., seem

to grow best when supplied with anionic nitrogen. It is not possible at present to say whether anionic nitrogen determines the growth response of plants or whether it is the nutritional complex commonly associated with available anionic nitrogen Wide nitrogen carbon ratios would very probably have much less effect upon the mobility of the cationic nitrogen from organic residues The basic nitrogenous materials from such residues undoubtedly function similarly to mineral bases in the soil colloidal complex These organic bases may partially satisfy the basic needs of the soil colloids, but the oxidation potential of such materials is apparently not sufficient to produce optimum growth of many plants The low oxidation potential of basic organic materials may partially account for the lack of close correlation between the hydrogen-ion concentration of a soil solution and plant growth. The desirable crop sequence in rotations and the succession of native plants on abandoned crop land, as well as the succession of plants on virgin soil, is probably closely correlated with the ability of various plants to utilize cationic nitrogen or non-ionized nitrogenous materials Basic material is very often the limiting factor in many of our depleted soils Nature has an abundant potential supply of basic material in the nitrogen of the atmosphere, but apparently many plants can not readily utilize low oxidation potential cationic nitrogenous materials

After failing to find sufficient correlation between the acidity of the soil and the availability of the basic nitrogenous organic residues to account for the difference in plant growth and associations, an attempt was made to correlate plant nutrition with the electromotive series and oxidation potentials As life is probably dependent upon a difference in electrical potential it was believed that the electromotive series and oxidation potentials, which are the best single expressions of the properties of ions, would correlate with plant growth The entire chemical activity of the metals corresponds fairly closely with the above series. Here we found a very striking correlation between the electromotive series and the absorption of plant nutrients Indeed the electromotive series may be the key to many of the perplexing problems in plant and animal physiology The various ions differ very much in the voltage they produce Such ions as K, Na and Ca produce high voltages, other ions, such as Mg, Al, Mn, NH_4, amines and other basic nitrogenous materials, produce medium voltages, while still other ions, such as Fe, H As, Cu, Hg, etc, produce very low voltages Various plants and animals apparently tolerate different potential levels Many crop plants, such as alfalfa, sweet clover, celery, barley, millets, asparagus, beets, etc, seem to be tolerant of very high electrical potentials as, for example, the potentials produced by high concentration of such ions as K, Na and Ca, often encountered in semi-arid to arid climates. Other plants, such as blackberry, blueberry, cranberry, raspberry, strawberry, oats, buckwheat, red top, cotton, sweet potatoes, watermelon, etc, grow well at relatively low potential levels as, for example, the potentials produced by high concentration of such ions as Mg, Al, Mn, NH_4, amines, protein acid salt ions, Fe, H etc It is evident that a given H-ion or OH-ion concentration resulting from the presence of various acidic or basic materials may produce different oxidation potential levels or physiological gradients. The gradients produced by such high potential materials as K, Na, Ca, etc, would be different from the gradients produced by such low potential materials as NH_3, amines, etc Hence a close correlation between H-ion concentration and plant growth could not be expected

Cropping may deplete various soil types until they reach approximately the same biological fertility level as, for example, the fertility level suited for the dominance of pine, etc Since the accumulation of basic nitrogenous materials is one of the important factors in the natural restoration of the productivity of soils, it is evident that the climax vegetation on different soils would be different, depending upon the ability of the soil colloidal complex to retain organic bases. Mass action resulting from the accumulation of organic bases may make available mineral bases that have a higher oxidation potential The capacity of the soil colloidal complex to retain the organic bases may partially determine the climax vegetation The above condition is probably one of the important factors controlling the more or less definite plant successions in the depletion and the restoration processes of various soil types Therefore, certain soil types can not be restored above the pine fertility level while others may be restored to levels suited to the various hard woods.

It has been possible to trace the influence of the oxidation potential levels from plutonic magmas to the various igneous rock, thence to the soil colloids, and finally through the plant to the animal The ash of certain plants, such as alfalfa, sweet clover, foxtail millets, etc, grown in semi-arid to arid climates may contain very large amounts of potash Ionic potassium may produce a very high voltage and it is, therefore, very readily absorbed by plants Under certain conditions the rapid absorption of the potassium or similar ions may exclude or limit the absorption of other desirable nutrient cations The feeding of large quantities of plants with high potash content may seriously affect animals. Another striking example of the effect of a high oxidation potential material is the probable correlation between high potash content in

fertilizers and tip burn in lettuce on certain high lime peat soils. It is necessary to have liberal amounts of potash to produce a satisfactory lettuce head, but if excessive amounts are added there is great danger of tip burn developing and this may result in a loss of the entire crop

Selective or differential absorption of nutrients by organisms is probably largely determined by the oxidation potential of the various ions The electromotive series and oxidation potentials are probably the key to the interpretation of the important works on antagonism and selective absorption by W M Bayliss, C M Child, G W Crile, D R Hoagland, J Loeb, M M McCool, W J V Osterhout, W Stiles and numerous other investigators

The bimodal growth or production curve so frequently met with in plant and animal physiology is probably closely correlated with the electromotive series and oxidation potentials. The hydrogen ion with an ionic velocity nearly five times greater than any other common nutrient cation very probably determines the mode on the acid side of the neutral point, and the hydroxyl ion with an ionic velocity nearly three times greater than any other common nutrient anion determines the mode on the alkaline side of the neutral point These two high velocity ions greatly influence the absorption of other ions, and are thus very important factors in regulating the growth or development of organisms

This paper is an attempt to outline briefly the significance of the correlation between the electromotive series and the oxidation potentials, and the nutrition of plants and animals. A more comprehensive statement of the whole subject will be presented in a later paper. It is very clear from the preliminary correlations which have been made that the electromotive series and the oxidation potentials afford a new and an important approach to the whole field of biology Electrochemistry has illuminated the subjects of chemistry and physics It will do likewise in the field of biology, when the biologist begins to appreciate more fully the relationship between electrochemistry and vital phenomenon

H P COOPER,
J K WILSON

CORNELL UNIVERSITY

INHIBITION OF ENZYMATIC ACTION AS A POSSIBLE FACTOR IN THE RESISTANCE OF PLANTS TO DISEASE[1]

SPECULATIONS and investigations on the nature of disease resistance in plants have occupied the minds and efforts of plant pathologists since the inception of the science of phytopathology in the classic work of de Bary[2] Fragmentary as is the evidence for the correlation of specific factors with specific internal resistance of certain species or varieties to particular parasites, it is sufficient to indicate that ultimate elucidation will probably be found in the domain of biochemistry

During the course of an investigation which seeks to throw some light on possible bases for the resistance of sour orange (*Citrus aurantium* L) and for the susceptibility of lemon (*Citrus limonia* Osbeck) to the bark diseases known as *Pythiacystis gummosis* and *decorticosis*, it has been found that the trunk bark of sour orange has a much greater inhibitory or paralyzing influence on the action of certain enzyms found in the dried mycelial powder of the causal fungi than does the trunk bark of lemon This suggests the possibility that resistance to the invasion of the pathogens may be due to the inhibition of one or more of the enzyms of the fungi by some cellular product of the host, and that a sufficient decrease in this paralyzing power might permit the hyphae to progress rapidly, as they do in the bark of the susceptible lemon, and successfully parasitize the host

Table 1 shows that the hydrolytic action of the diastase and invertase found in the dried mycelium of both *Pythiacystis citrophthora* and *Phomopsis californica* was inhibited more by sour orange bark than by lemon bark Bark of tangelo, a hybrid of pummelo and tangerine, which has been found by inoculation tests to be very resistant to Pythiacystis, showed about the same degree of inhibition of fungus diastase and ptyalin as sour orange did. It is not to be expected that all enzyms would be similarly affected Urease in fact was not thus inhibited. Other enzyms are being tried

The "cultures" were made by placing in a 200 ml Erlenmeyer flask 20 ml of the substratum, 500 mgm. of the bark and 250 mgm or 5 ml of the enzym source One ml of toluol was added as a preservative, the flasks tightly stoppered, and the "cultures" incubated in the dark for 36 to 48 hours at 40 degrees C At the end of the incubation period the "cultures" were filtered and a 10-ml portion of the filtrate placed in 25 ml. of solution A of Fehling's reagent to stop enzymic action Reducing sugars were determined by the Shaffer and Hartmann iodometric method[3] and the results calculated as milli-

[1] Paper No. 178, University of California, Graduate School of Tropical Agriculture and Citrus Experiment Station, Riverside, California.

[2] Bary, A. de, "Ueber einige Sclerotinien und Sclerotienrankheiten," *Bot. Ztg* 44 377–381, 1 fig , 393–404, 409–426, 433–441, 449–461, 465–474, 1886

[3] Shaffer, P A., and Hartmann, A F , "The Iodometric Determination of Copper and its Use in Sugar Analysis," *Jour. Biol. Chem* 45. 349–390, 1920.

TABLE I

INHIBITION OF ENZYMIC ACTION BY CITRUS BARK

No.	Substratus	Source of enzym	Inhibition due to. Sour-orange bark mgm Cu	Lemon bark mgm. Cu	Tangelo bark mgm. Cu.
1	10 per cent Sucrose	Pythiacystis	3.6482	– 1664	———
2	1 per cent. Sucrose	Pythiacystis	6 9488	3.8184	———
3	1 per cent. Lintner's starch	Pythiacystis	14 2406	11 6272	———
4	1 per cent. Lintner's starch	Malt diastase	9 9416	6.4328	———
5	1 per cent Lintner's starch	Phomopsis	16.2636	13.0835	———
6	1 per cent Lintner's starch	Pythiacystis	12.1254	8 4568	12 0162
7	1 per cent Lintner's starch	Saliva	14 4352	10.8264	14 7475

grams of copper. The intrinsic reducing power of both the active and autoclaved bark and enzym materials in water was used in all the calculations. To illustrate

$$\begin{pmatrix}\text{Reduction}\\ \text{by enzym}\\ \text{+ substrate}\end{pmatrix} - \begin{pmatrix}\text{Reduction}\\ \text{by enzym}\\ \text{+ water}\end{pmatrix} - \begin{pmatrix}\text{Reduction by}\\ \text{autoclaved}\\ \text{enzym + substrate}\end{pmatrix} + \begin{pmatrix}\text{Reduction by}\\ \text{autoclaved}\\ \text{enzym + water}\end{pmatrix} =$$

Reduction due to the hydrolytic products of enzymic action.

The necessity for such a method of calculation was pointed out by Klotz[4] and is here illustrated farther.

Suppose

		Mg Cu
	A. Starch solution plus active enzyme gave a reduction	25
and B	Active enzym alone	5
and C	Starch solution plus autoclaved enzym	2
and D	Autoclaved enzym alone	1
and E	Starch solution alone	0

then it is seen that the inactivated enzym in the presence of the substrate (starch) produces some substance capable of reducing Fehling's solution; that is, there is present a catalytic effect other than the enzymic effect It is assumed that this property also resides in the active unheated enzym. Therefore, the reduction due to hydrolyzed starch, that is, the reduction due to truly enzymic action is evidently not A minus C or 25 minus 2 equals 23, but A minus B minus C plus D or 25 minus 5 minus 2 plus 1 equals 19. The value of D (equals 1) must be added because the intrinsic reducing power of the autoclaved enzym was present also in *C*.

The figures in Table 1, it should be noted, do not represent actual copper reduced, but inhibition expressed in milligrams of copper per milliliter of filtrate They were obtained by subtracting the reduction value of the system, enzym + bark + substrate, from the sum of the values of the two systems, enzym + substrate and bark + substrate, that is, the figures represent loss in reducing power due to the inhibiting effect of the bark on the fungus or *vice versa*. Each horizontal row of results represents a series of cultures. The bark of the first five series was obtained from twelve-year-old lemon trees growing on sour-orange stocks, approximately equal quantities of bark above and below the bud union being taken at the same time The bark material of lemon and tangelo reported in series 6 and 7 was from twelve-year-old lemon trees in another orchard and the sour-orange bark from a seedling tree near the tangelo. Inoculation tests have indicated that seedling trees of sour orange may be slightly more resistant to *Pythiacystis gummosis* than sour orange used as a stock

The above data are offered as a suggestion for a possibly new line of attack. So far as is known this inhibiting or paralyzing effect of the plant tissues themselves upon certain fungal enzyms has not been suggested or tested as a possible basis for disease resistance in plants. The paralyzing effect on enzyms of some of the end-products of enzymic reactions, as hydrocyanic acid, benzaldehyde and hydroquinone, and also of the salts of heavy metals, is well known. It is suggested that any one or more of several cellular products might behave similarly. In work of this kind the necessity for check determinations on all materials used is here stressed again. The extension and test of the idea with other hosts, pathogens and enzyms are being continued at this station and it is hoped that others may see fit to test it.

L. J. KLOTZ

COLLEGE OF AGRICULTURE,
UNIVERSITY OF CALIFORNIA

[4] Klotz, L. J, "The Enzyms of *Pythiacystis citrophthora* Sm and Sm.," Hilgardia 3 27–40, 1927

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THE NOTION OF PROBABLE ERROR IN ELEMENTARY STATISTICS[1]

What I have to say to-day is not addressed to professional mathematicians or statisticians To mathematicians and statisticians all that I shall say is already entirely familiar There are two other classes of readers, however, to whom I hope the discussion may be of service (1) the rapidly increasing number of laymen who, without technical mathematical training, are constantly coming upon such terms as "probable error" in their general reading, and (2) the non-mathematical research worker who is constantly tempted to embellish his numerical results by adding an imposing array of "probable errors"—obtained, alas, too often by the simple process of substituting blindly in a formula. (A formula, of course, is an essential tool, what will concern us here, however, is the underlying significance of such a formula, and the necessary limitations surrounding the proper use of it)

What are the principles that lie behind the common use of the term "probable error"? What does it really mean when we say, for example, that a quantity x has an estimated value of 3.6 with a "probable error" of 0.2 (written $x = 3.6 \pm 0.2$)?

The conventional reply to this question will occur to all of us—namely, that "the probable error is the error that is as likely as not to be exceeded" For example, if $x = 3.6 \pm 0.2$ the conventional understanding is that the "true value" of x is as likely to lie outside the limits 3.4 and 3.8 as it is to lie between those limits

But this conventional reply does not go very far behind the scenes—we should like to have something more fundamental Under what circumstances can we properly speak of errors as "equally likely" to occur? What are the fundamental considerations underlying the whole range of ideas which are suggested by the term "probable error"? I believe the best modern opinion is in favor of treating the so-called "probable error" from the point of view of empirical statistics, with as little reference as possible to the technical theory of probability; and I am convinced that much misunderstanding will be avoided if we can keep as

[1] Address of the retiring vice-president and chairman of Section A (Mathematics), American Association for the Advancement of Science, Nashville, Tennessee, December 29, 1927

far away as possible from the older language of probability.

A Errors of Measurement

The earliest use of the term "probable error" which I can discover is in a paper by Bessel in 1815 Bessel, following some then recent methods of Gauss, was discussing a problem in the adjustment of measurements of an unknown quantity Let us begin, therefore, with a brief outline of the problem of *adjustment of measurements* This problem is conveniently treated under two headings, first, the "probable error of a single observation" and secondly, the "probable error of the mean"

I *The "probable error of a single observation"*

Suppose we have before us a large number of measurements of an unknown quantity, suppose next that we take the arithmetic mean of these measurements, and suppose further that we compute the deviations of the given measurements from the mean. If the number of measurements is large many of them will coincide exactly with the mean value; and among those which differ from the mean, small deviations will occur more frequently than large ones

If now we lay off the values of the given measurements along an axis of abscissas, and at each point of this axis erect an ordinate which shows the number of times that the corresponding measurement occurs, we shall have a *frequency diagram* or *distribution diagram* for the given set of measurements The area of the diagram (or, rather, the area divided by the smallest recognized interval along the axis) will be equal to the total number of measurements in the set. The actual form of the diagram for a given set of measurements is a matter of experience. In a large number of cases, however, the distribution is found to conform to what is known as the *normal law of error*, represented by the familiar bell-shaped curve whose equation can be found in any book on statistics. If the measurements are closely consistent with each other, most of the deviations from the mean will be small and the distribution curve will be sharply peaked; if the measurements are less consistent—that is, more scattered—the curve, though of the same area, will be flatter

The question at once arises. how shall we secure some estimate of the consistency of the given set of measurements? One method for doing this is as follows we may divide the area of the distribution curve into four equal parts by ordinates erected at the points $x=-r$, $x=0$, $x=+r$, where x is measured from the mean; the value r will then have the property that just half of the deviations from the mean will lie between $-r$ and $+r$. This value r is called, after Galton, the *quartile deviation* of the given set of measurements, and may obviously be taken as an indication of the consistency of the measurements, the smaller the quartile deviation the more closely packed are the measurements about their mean

By an unfortunate use of language, for which Bessel and Gauss are chiefly responsible, this quartile deviation is commonly known as the "probable error of a single observation," for the given set of measurements This term "probable error" is here used in a highly technical sense and does not mean at all what it would appear to mean in ordinary language. It is best interpreted as merely an obscure synonym for the clearer, almost self-explanatory, term quartile deviation The important thing to note is that the "probable error of a single observation," in spite of its name, is not a property of any single measurement, but a property of the whole set of measurements, it enables us to say, not that any single item is more accurate than another single item, but that one whole set of measurements is more consistent with itself than another whole set of measurements. The term is used chiefly in statements describing the precision of an instrument, or the precision of some measuring process It is not often used as the $\pm 0\ 2$ that one sees annexed to numerical values

This, then, is the first common use of the term probable error, the so-called "probable error of a single observation" means merely the quartile deviation of the given set of measurements, it serves to indicate the self-consistency of the set of measurements, or the peakedness of the distribution diagram

II *"The probable error of the mean"*

The second common use of the term "probable error" is in the phrase "probable error of the mean" The conventional explanation of this phrase runs somewhat as follows suppose we have a given set of n measurements, conforming to the normal law of distribution, and having a definite mean and a definite quartile deviation. Next, let us *pretend* that we have also a large number of similar sets of measurements of the same quantity, making k sets in all, each containing n measurements; and consider the k means belonging to these k sets. These means will constitute a sort of super-set of k values which will have its own distribution diagram, its own mean and its own quartile deviation. By a subtle application of the theory of probability, the quartile deviation of this super-set is proved to be equal to the quartile deviation of the original set divided by the square root of n; and this value is what is called the "probable error of the mean," for the original set.

This conventional explanation leaves much to be desired. What is the use of pretending that we have a

"super-set" composed of "a large number of sets of measurements similar to the given set" when we have in reality only one set to work with? And why should the quartile deviation of this hypothetical super-set be of any significance in the problem of measurement?

When one examines the actual use that is made of the so-called "probable error of the mean" one finds that it is almost always associated with *the problem of combining several sets of measurements*, with a proper "weight" attached to each set. In the practical solution of this problem there is no question of a hypothetical super-set of imaginary sets of measurements, all the sets of measurements with which we are concerned are actually given. Two illustrations will make the practical method clear

First, suppose we have two normal sets of measurements of equal consistency, one containing ten measurements, the other twenty In combining these two sets of measurements it is natural to give the second set twice as much weight as the first, since the number of measurements in the second set is twice as great as the number of measurements in the first The combined mean or "weighted average" of the two sets will then be the mean of the first set plus twice the mean of the second set all divided by three. The justification of this process of computing the weighted average of two such sets lies in the fact that it gives exactly the same result as if we had taken all thirty measurements as a single set of measurements and found the mean of this set in the ordinary way.

Secondly, suppose we have two sets of measurements containing the same number of items, but having unequal consistency Suppose for example that the quartile deviation of the first set is $r_1 = 3$, and the quartile deviation of the second set is $r_2 = 4$ Before combining these two sets of measurements, we must first reduce them, so to speak, to a common denominator. To accomplish this we may make a photographic enlargement of both diagrams, until the quartile deviation of each is equal to the same number, in this case 12. This step is justified by the natural assumption that two distribution diagrams which are similar—that is, one merely an enlargement of the other—are of equal weights. Here, in the case of the first diagram we multiply the linear dimensions by 4, and therefore the area by 16; and in the case of the second diagram, we multiply the linear dimensions by 3, and therefore the area by 9; the position of the mean in each case being unchanged. The quartile deviation of each diagram is now equal to 12, so that the two revised sets of measurements are of equal consistency and can be combined by the method just described. Remembering that the area of a distribution diagram is proportional to the number of measurements, the first set must be given a weight of 16, and the second set a weight of 9. The weighted mean will therefore be equal to 16 times the first mean, plus 9 times the second, all divided by 25.

It is easy to show that the same result would have been obtained if we had multiplied the first mean by a weight equal to $(1/r_1)^2$, and the second mean by a weight equal to $(1/r_2)^2$, and divided by the sum of these weights

The extension of this process to the combination of the two cases namely, to the case of several sets of measurements which differ not only in consistency but also in the number of measurements in each set, presents no difficulty We are thus led at once to the following general rule for combining any number of sets of observations which are normally distributed: *the weight to be attached to each set is directly proportional to the number of measurements in that set and inversely proportional to the square of the quartile deviation of the set*

I hope that this brief sketch of the practical method of combining sets of measurements will make it clear that the whole subject can be presented without reference to anything except what is immediately given by the actual measurements, it is not necessary to bring into the discussion any hypothetical super-set of imaginary sets of measurements or to make any use of the technical theory of probability. The ± 0.2 placed after the numerical statement of a mean value is commonly called the "probable error of the mean." This is a quantity obtained by dividing the quartile deviation of the given set of measurements by the square root of the number of measurements in the set, it is best regarded as merely a conventional way of indicating one step in the computation of the weight which should be attached to the given value when this value is to be combined with other values of a similar nature. It is not necessary to think of it as something mysteriously connected with the theory of probability.

It is interesting to note in passing that there is another measure of the consistency of a set of measurements, which is coming more and more into use. This is the *standard deviation*, or mean square error, introduced (under the name "mean error") by Gauss in 1821. The standard deviation is the square root of the mean of the squares of all the deviations from the mean; in the case of the normal curve it proves to be simply the abscissa of the point of inflection (measured from the mean). For this curve, as is well known, the standard deviation, σ, and the quartile deviation, r, are connected by the relation $r = 0.6745\sigma$, and the ordinary method of computing the quartile deviation is first to compute the standard deviation directly from the given measurements, and then to multiply by 0.6745. The quartile deviation (or "prob-

able error") is thus about two thirds as large as the standard deviation (or "mean square error"), in the case of the normal curve

A pretty quarrel has arisen as to which of these two quantities is the handier one to use as an indication of the consistency of a set of measurements Gauss himself began in 1816 with the exclusive use of the probable error In 1821 he uses the mean square error and the probable error side by side. By 1828 he begins to speak of the probable error as the "so-called" probable error, and a few years later he is quoted as saying "the so-called probable error, I, for my part would like to see altogether banished" In 1889, Francis Galton, the grandfather of the British school of statistics, condemns the term probable error in vigorous language. "It is astonishing," he writes, "that mathematicians, who are the most precise and perspicacious of men, have not long since revolted against this cumbrous, slip-shod, and misleading phrase" Many recent writers like R. A Fisher agree that the fact that the use of the probable error is common "is its only recommendation" On the other hand, Professor Mansfield Merriman (1884) regards the probable error as the most natural unit of comparison and insists that it alone should be used and the mean square error be discarded. At the present time both the probable error (or quartile deviation) and the mean square error (or standard deviation) are so thoroughly established in the literature that neither of them is likely to be given up.

Let us now leave the subject of errors of measurement and pass on to another use of the term "probable error," namely, its use in connection with the subject of random sampling—a subject which is coming more and more to occupy the central position in the whole modern theory of statistics.

B Random Sampling

In the problem of errors of measurement, the final result desired is the value of a single unknown quantity, and the distribution diagrams of sets of measurements of the unknown are merely means to an end In the problem of random sampling, however, the final result desired is the distribution diagram itself.

For example, a shoe manufacturer wishes to know what demand he may expect for various sizes of shoes He wishes to know, for example, what proportion of the population wears a number eight shoe. What he needs is a distribution diagram of the foot-sizes of the whole population This distribution diagram will exhibit, of course, a certain mean value; but this mean value is not now the interesting thing, and the deviations from the mean, instead of being errors to be avoided, are now important for their own sakes. The distribution diagram itself is the thing that is wanted. Now the distributions that occur in practice are by no means always of the normal form, a frequency diagram may often be "skewed" in one direction or the other; it may be more sharply or less sharply peaked than the normal curve of the same area and same quartile deviation; or it may even be of a U-shaped form, with the large deviations from the mean more frequent than the small ones.

In order to describe a distribution diagram concisely we may state the values of four parameters, two of which we have already mentioned: (1) the mean, (2) the standard deviation, that is, the square root of $1/n^{th}$ of the sum of the squares of all the deviations from the mean, (3) the third moment, that is $1/n^{th}$ of the sum of the cubes of the deviations from the mean; and (4) the fourth moment, or $1/n^{th}$ of the sum of the fourth powers of the deviations from the mean

The standard deviation, as we have seen, gives a measure of "dispersion" or "scatter." (If the distribution happens to be symmetrical, either the standard deviation or the quartile deviation may be used as a measure of dispersion, but in the general case the standard deviation alone is available) The third moment leads to a measure of "skewness." The fourth moment leads to a measure of what Pearson calls "kurtosis." Any given distribution diagram is sufficiently characterized for most purposes by giving the values of these four parameters, the mean, the standard deviation, the third moment, and the fourth moment.

Let us suppose then that our shoe manufacturer desires to study the distribution of foot-sizes in the whole population of a hundred million people. He obviously will find it impracticable to measure the whole population, so that he can not obtain the parameters of the distribution directly He therefore takes a sample of a moderate number, n, of people, chosen, as we say, at random, and determines the parameters of this sample. The question is, what conclusion can be drawn about the mean, standard deviation, etc, of the total population from a knowledge of the mean, standard deviation, etc., of a single sample?

This question is being actively discussed at the present time, and all that I can do here is to indicate briefly the nature of the answer that may be hoped for. Suppose, for example, that the parameter in which we are interested is the mean. Consider the totality of all possible samples of n which can be drawn from the population in question. The number of such samples will of course be enormously large, but can be readily computed by the theory of permutations and combinations. Each sample of n will have its own mean; and the set composed of the means

of all the samples will be distributed in a perfectly definite way, depending on the nature of the total population.

Thus, it has been proved that the mean of the set of means will coincide with the mean, m, of the total population, the standard deviation of the set of means will be equal to $\sigma/\sqrt{n}$, where σ is the standard deviation of the total population; and the other moments of the set of means can be computed in terms of the corresponding moments of the total population That is, if we assume any hypothetical values for the parameters of the total population, we can theoretically compute the parameters of the distribution of the means. Then by a subtle analysis, we can make a comparison between the distribution of the means and the observed properties of the given sample, and thus construct a test of the validity of our assumed values

The result of such a test is commonly recorded in this form · the required mean, m, is equal to the observed mean, a, of the measured sample, plus or minus a "probable error" r This indicates merely that if we had the totality of the means of all possible samples of n before us, 50 per cent of these means would lie between $a+r$ and $a-r$ This use of the term "probable error" is unsatisfactory, however, since the distributions involved in the analysis are usually not symmetrical, the "standard deviation" is the more useful concept Moreover, there is no special sanctity attached to the arbitrary choice of "50 per cent", other ranges are often needed

Moreover, the formulas commonly given for computing the probable error of the various parameters are only approximations which are not valid unless the original distribution is normal, and the size of the sample is large The serious study of this whole question, for the general case of skew distributions and small samples is a product of the last two decades—one might almost say of the last two years Some of the names associated with this study are Karl Pearson, R A Fisher, Tchouproff, and especially a learned British scholar who conceals his identity behind the modest pen-name of "Student." Exciting new developments are constantly appearing in *Biometrika* and similar journals, the most modern tools that mathematics can supply as, for example, the theory of integral equations, are called into play; and the very latest results are immediately put to use by practical statisticians of the Bell Telephone System and other great industrial concerns The work is by no means completed, and even the exact nature of the answer that may be hoped for is not yet entirely clear.[2]

[2] For further information the reader is referred to H. L. Rietz's Monograph on Mathematical Statistics (Open Court Publishing Company, 1927).

A splendid field for research is opening up, the fruits of which are sure to be not only of the greatest theoretical interest but also of the highest practical utility.

EDWARD V. HUNTINGTON
HARVARD UNIVERSITY

THE GENERAL RADIATION[1]

THE impacts of electrons against atoms produce two different kinds of radiation, (a) the line spectra and (b) the general radiation, sometimes called the continuous, or white, spectrum The general radiation usually carries a far greater amount of energy than the line spectra—hot body radiation, for instance. This is true of the X-ray region of the spectrum as well as of other regions Although X-ray spectrum lines are often strongly marked and sharply defined, the general radiation contains more energy than the lines, for it covers a much greater range of wave-lengths In the evolution of recent thought, however, less attention has been paid to the general radiation than to the line spectra, partly because the line spectra have important bearings on our ideas as to atomic energy levels. In this address, I wish to present to you the more important characteristics of the general radiation, as they have been discovered by about twenty men, carrying on researches in different parts of the world Time will not permit a detailed account of the subject These details may be found in the text-books, which contain numerous references to the original articles published by the investigators

On account of the fact that homogeneous beams of high-speed electrons can be produced, accurately controlled and measured, and because each electron has a relatively large amount of energy, the X-ray region of the spectrum provides us with a better field for investigating general radiation than do other regions.

The curve representing the distribution of energy in the general X-radiation spectrum as a function of the wave-length resembles that for the spectrum of black body radiation. There is one important difference between the two, however, namely, the general radiation spectrum has a sharply defined short wave-length limit. The quantum theory explains this limit quantitatively and qualitatively, for the electrons striking the atoms of the X-ray tube's target can not have kinetic energies greater than the product of the electron's charge into the difference of potential through which it has fallen (namely, Ve) Therefore, the $h\nu$ value of the quanta of radiation produced can not be greater than Ve. Strictly speaking, if we apply the laws of the conservation of energy and momentum to the impact of an electron against an atom, we find that the value of

[1] Address of the vice president and chairman of Section B (Physics), American Association for the Advancement of Science, Nashville, Tennessee, December, 1928.

hv can not be quite equal to that of Ve, as required by the quantum equation, for the electron must, in general, transfer some of its momentum to the atom, and the atom will, therefore, retain at least a small amount of the electron's kinetic energy The corresponding correction term that must be subtracted from Ve in the quantum equation contains the ratio of the mass of the electron to that of the atom as a factor It is, therefore, very small, so small indeed that it can not be detected experimentally—at least in the case of heavy atoms. If it turns out that the impacts of protons against atoms, or of atoms against atoms, also produce general radiation with short wave-length limits, it may be possible to detect and verify the correction term.

The short wave-length limit of the general radiation does not appear to depend upon the angle between the direction in which the X-rays travel and that of the stream of electrons which produced them The limit is also independent of the substance composing the target of the X-ray tube It depends only upon the maximum voltage through which the electrons fall.

By measuring the voltage applied to an X-ray tube and the frequency of the short wave-length limit of the general radiation, we get an experimental value for the ratio of h to e. Using the accepted value of e, 4.774×10^{-10} we find for the value of h, 6.556×10^{-27} Some recent determinations of h by means of spectroscopic analysis, using Bohr's formula for the Rydberg constant, give values that differ from the above by only a very small fraction of one per cent The accuracy of the two methods is about the same

The general radiation extends from the short wave-length limit toward longer wave-lengths, reaching a maximum of intensity at a certain point, the exact position of which depends upon experimental conditions After making corrections for the absorption by the matter through which the X-rays pass and for the reflecting power of the crystal grating, it has been found that, at right angles to the electron stream, the maximum intensity of a beam, unaltered by transmission through matter, occurs at a wave-length approximately fifty per cent longer than the short wave-length limit The position of the maximum, however, depends slightly upon the angle between the X-rays and the electron stream The maximum point shifts towards the short wave-length limit as this angle decreases

The total intensity radiated in the general radiation spectrum has been measured both by means of its ionizing effect and also by means of its heating effect. It has been found that, other conditions remaining the same, the total intensity increases almost exactly as the square of the voltage applied to the tube. Since the energy of the electrons increases as the first power of the voltage it appears that the *efficiency* of production of X-rays, also, increases as the first power of the voltage, in other words, as the first power of the energy of the electrons. It is interesting to note that this is an energy law, for the measurements have been carried up to such high voltages that the relativity correction for the kinetic energy of the electron becomes important. At the highest voltages used the kinetic energy of an electron exceeds the value of $\frac{1}{2}mv^2$ by as much as twenty per cent.

The total intensity of the general radiation measured by ionization methods increases with the atomic number of the chemical element composing the target Where the order of atomic weights of the chemical elements differs from the order of their atomic numbers, the intensity of the radiation follows the order of the atomic numbers. The intensity is nearly proportional to the first power of the atomic number, there being a small, positive correction term proportional approximately to its second power This means that the probability that the impact of an electron against an atom will produce general radiation does not depend upon the atom's *mass*, but upon the nuclear charge or the number of electrons in it

General radiation is partially polarized. In terms of the electro-magnetic theory of radiation, the electric vector at a point is a maximum in the plane containing the stream of electrons that produce the radiation. The amount of polarization appears to increase as we approach the short wave-length limit of the general radiation spectrum. This agrees with the ideas contained in the classical theory of radiation, and with the idea that, in impacts of electrons against the solid target, the radiation near the short wave-length limit is produced by electrons that have not lost much energy, or had their directions of motion changed much, before they actually produce the radiation.

The way in which the intensity of a small portion of the general radiation spectrum of breadth $\delta\lambda$ varies with the difference of potential through which the electrons fall has been examined. The relation between the intensity and the applied voltage seems to obey very well a certain, somewhat complicated, equation From the experiments performed in solving this problem, it has been deduced theoretically that the general radiation from an indefinitely thin target should have a maximum at the short wave-length limit and should fall off beyond this limit (toward longer wave-lengths) in the inverse ratio of the square of the wave-length.

Until recently experiments on the general radiation have been performed with solid targets only. Although the line spectrum of a liquid mercury target has been observed, there do not seem to be any observations on the general radiation from a liquid target.

Presumably such general radiation would have the characteristics of the radiation from a solid target

Experiments have recently been made on the radiation coming from the impacts of electrons against gas atoms at low pressures. In these experiments, a stream of mercury vapor in a mercury pump passed down through a metal anode joined to earth and electrons, after falling through a constant difference of potential, passed through a hole in the anode and struck the mercury atoms The radiation coming from these impacts through suitable openings has been examined It has been found that the radiation at right angles to the stream of electrons has an average, or effective wave-length only a few per cent longer than the short wave-length limit of the radiation as calculated from the quantum theory In these experiments, the voltage applied to the tube was not sufficient to produce the L series lines of the mercury This effective wave-length lies nearer the short wave-length limit than would be expected, if the intensity of the radiation fell off from the limit as the inverse square of the wave-length.

A number of interesting theories have been proposed in order to explain the characteristics of general radiation. Soon after the general radiation spectrum had been analyzed by means of crystal spectrometers, various assumptions were made as to the probability that an electron's impact against an atom would produce radiation and how much energy would be radiated It was found that, by using the quantum theory and proper assumptions, a theoretical curve could be drawn which represents, at least roughly, the distribution of energy actually observed in the spectrum

Another theory has been based on the application of Bohr's correspondence principle to the radiation, calculated on the classical theory for an electron approaching a nucleus It gives the distribution of energy in the general radiation spectrum coming from an indefinitely thin target This theory does not explain the short wave-length limit of the spectrum It is arbitrarily assumed that the spectrum will be cut off at the short wave-length limit determined by the quantum theory The theory predicts that beyond the limit, toward longer wave-lengths, the intensity of the general radiation will fall off approximately as the inverse square of the wave-length The theory contains, also, an estimate of the total energy radiated, which appears to be of the right order of magnitude

No solution of this problem by means of the theory of wave mechanics has been published When such a solution is published, it will be interesting to see whether it explains the short wave-length limit of the spectrum and gives the same value for it as that deduced from the laws of energy and momentum applied to the production of a light quantum, and, further, whether it gives the correct distribution of energy in the spectrum of radiation from solid and gas targets.

At present, there does not seem to be a complete theory of the fundamental radiation problem, namely, that, if we allow an electron having a certain kinetic energy to impinge against an atom, shortly afterwards something of the same order of magnitude happens in a neighboring atom. From the point of view of theories, therefore, we are obliged to content ourselves with the application of the laws of energy and of momentum to the production and absorption of light quanta. These laws, as applied to the individual impacts of light quanta against electrons, have had extraordinary success in predicting and explaining that great discovery, made in America, which we call the "Compton Effect," and which we owe to the ability of our present chairman.

I can not allow the annual address of the retiring chairman of Section B to be delivered this year without commenting, also, upon a second great discovery, the selective reflection of electrons by crystals, the details of which Dr Davisson will describe to us in a few minutes. Some years ago, in order to explain the reflection of light quanta by gratings and similar phenomena, a theory was proposed according to which the corpuscles transfer momentum to the grating in quanta. The magnitude of these quanta equals h divided by the grating space It was shown that the law of quantum transfer of momentum accounts for those phenomena which we class under the heading of Fraunhofer diffraction[2] If we introduce into the theory a quantity, λ, defined by the relation that λ equals h divided by the momentum of a radiation corpuscle, the equations of the theory take precisely the forms of those derived from the theory of the interference of waves, in which λ is the wave-length. Soon after this theory was proposed, discussions arose as to whether other forms of corpuscular radiation might not obey somewhat the same laws as those governing the diffraction of light quanta. It was suggested that radiation consisting of moving electrons, moving protons and even moving atoms ought to be reflected from gratings at least approximately in accordance with the laws of grating reflection The ideas contained in the theory of wave mechanics seemed to offer an explanation for such reflections. There is, however, one possible difference between the theory of the transfer of momentum in quanta and the theory of wave mechanics. According to the theory of the transfer of momentum in quanta, the corpuscle should lose at least a small amount of its momentum and energy on reflection. It might lose much more on account of some electrical disturbance it produced, the ionization of some atom, for instance. The equations for the reflection of a corpuscle by a crystal grating that represent the

[2] The explanation of Fresnel diffraction seems to require further assumptions.

quantum transfer of momentum in three rectangular directions may be written:

$$mv\alpha - mv^1\alpha^1 = n_1 \frac{h}{d_1}$$
$$mv\beta - mv^1\beta^1 = n_2 \frac{h}{d_2}$$
$$mv\gamma - mv^1\gamma^1 = n_3 \frac{h}{d_3},$$

The d's represent grating spaces, the Greek letters direction cosines and the n's whole numbers, in which v^1, the velocity of the corpuscle after reflection, may differ from v, its velocity before reflection. If v^1 is equal to v and if we put $\lambda = h/mv$, the above equations reduce to those derived from the theory of wave motion. If we look at the phenomenon of reflection of corpuscles from the point of view of the elementary wave theory, we may suppose the corpuscle to be replaced by a series of plain waves having a definite wave-length and we may suppose that these waves excite oscillations in the atoms of the grating which send out secondary waves. The interference of these secondary waves produces the reflected or diffracted beam. On this theory we would expect the frequency of vibration of the diffracted beam to be the same as that of the primary beam. We would expect, therefore, that the diffracted corpuscle would have the same energy, momentum and velocity as the corpuscle had before diffraction. It has been found, however, in the experiments which Davisson and Germer described in the December *Physical Review* that the reflected electron in general has less energy after reflection than before and that the loss of energy may amount to as much as twenty-five per cent. The fact that they observed electrons with such losses of energy appears to be explained by the above momentum equations as due to the sizes of the slits in their measuring apparatus.

No general solution of the equations representing the wave mechanics as applied to this problem has as yet been found. It may be that a general solution of the equations would indicate some loss of energy and momentum on reflection. If so, it will be interesting to see whether the angles at which reflection takes place are the same as predicted by the above momentum equations. According to these momentum equations, if the corpuscle loses a certain definite amount of energy, it must be reflected at certain definite angles from the crystal grating.

Although no completely satisfactory theory has been proposed for the radiation problem in general, it may be that we are gradually approaching a solution of it. A number of interesting physical theories have been proposed in recent years. A physical theory, however, does not represent what we might call real truth. A physical theory is a collection of fundamental hypotheses and general laws, which may be used to deduce particular laws that can be applied to concrete facts. Physical theories are useful, if they explain a large number of facts in simple ways, and if they furnish definitions of terms and a nomenclature to be used in describing phenomena. Physical theories are tools and not creeds, but one is at liberty to believe they represent reality, if one wants to. The belief in a physical theory, however, is a similar process of thought to the belief in religious tenets. The greater the number of useful physical theories that are proposed, the greater the number of good tools we shall have at our disposal, to use in discovering the real truth about the way in which nature acts, for it is the way in which nature acts that is the prime object of physical research. The multiplicity of theories in physics to-day really represents a healthy growth.

WILLIAM DUANE

HARVARD UNIVERSITY

FUNDAMENTAL SCIENCE AND WAR

MUCH has been said and written about war's effect on civilization, much has been said and written about war's effect on applied science and modern invention. Indeed the two are almost inseparable for the "degree of civilization of a people is commensurate with the extent to which they accumulate, correlate and utilize knowledge."[1] It is now universally realized that applied science progresses only after the foundation stones of pure science have been firmly laid. The process of laying this foundation consists in searching out, correlating and classifying knowledge. It is of this process that the layman is hardly aware, except that he knows it is carried on to a great extent in the academic world, in the laboratories of our colleges and universities. What would happen to civilization if this process were to cease? Is this process a continuous one? Is it affected by political influences? What is the effect of war on this apparently endless task?

It is the purpose of this paper to discuss the effect of the great war on one of the fundamental sciences —chemistry. In America we feel that chemistry is making great strides. We agree, and rightly, with Calvin Coolidge, who, in addressing the American Chemical Society on the White House lawn on April 24, 1924, said in part: "Wherever we look the work of the chemist has raised the level of our civilization, and has increased the productive capacity of the nation." We feel that the war caused an awakening in chemistry in this country. What its effect has been

[1] J. Alexander, Preface of "Colloid Chemistry" (1926).

TABLE I

Year	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Total number references	118	124	127	92	96	93	73	110	155	196	230	374
Non-U. S. A.	91	91	82	48	42	35	26	61	67	78	116	158

elsewhere we seldom ask, nor do we often find a satisfactory gauge with which to measure effects of this kind It is hoped that the method of investigation chosen by the writer will serve as such a gauge to answer this question for the world as a whole, and more particularly for Germany, England and the United States

Research in fundamental science is of little or no value to the progress of a nation unless it is more or less widely disseminated among scientific men, so that they may use the results to strengthen the structure which they are attempting to build This dissemination usually is carried out by publication in the journals of scientific organizations If we page through the current chemical publications we find that an investigator is giving us continually citations to previous work of former investigators It is by studying these citations that we can answer the question which we have set for ourselves If we choose the most representative publication of American chemistry, the *Journal of the American Chemical Society,* we find that in the last complete volume, 1926, there are reported the results of 459 separate investigations in pure chemistry The writers of these reports give us 4,857 citations to previous work These references

FIG. 1

are to 247 different periodicals and the international scope of science is manifest when one sees that there are represented journals from almost every civilized country in the world.

If we first tabulate the references to articles published from 1912 to 1923, inclusive, according to the year of publication but without reference to the specific country of origin the results in Table I are obtained

In Figure 1 we have graphically represented the first row of figures The solid line is not supposed to represent a continuous functional relationship but serves only to show the trend of results from year to year It will be seen at once that there is a marked decrease in the number of references to articles published in 1915 when compared with the practically static level reached in 1912, 1913 and 1914. We must conclude that there was indeed a falling off in the amount of research in chemistry successfully completed in 1915

It must be remembered that there will be quite naturally more references to the years immediately preceding the year of publication (1926) of the articles from which the citations have been taken We should also expect the slope of the "trend-curve" to become greater the nearer we approach 1926 It is because of this difficulty of deciding what might be called "normal behavior" that the years following 1923 are omitted from consideration. Undoubtedly, however, this effect is noticed in the high figure for 1923 and possible also to some extent in that for 1922 That this is true will be seen when one considers that much of the work published in 1926 in the *Journal of the American Chemical Society* was completed and submitted for publication in 1925 Conditions under which academic work is carried out make it highly probable that many of the researches were begun in 1924 In a sense, then, 1923 is very recent as far as literature citation is concerned.

Consideration of the method of investigation here employed will show that we are concerned not merely with the quantity of work published during this period (1912–1923), but that in reality we are concerned only with the good work, the work which has survived and which has proved of value to the investigators who followed The method, therefore, has a distinct advantage over any method which counts pages or number of papers published in various journals for its basis of comparison.

If we examine the trend-curve in Figure 1 more closely we find an increase to a maximum in 1916–17 A maximum, to the chemist, at once suggests compound formation In this case it would indeed seem to indicate a compounding of two results a decrease in one country coupled with an increase in another, the latter becoming more rapid than the former in 1916. That this is actually the case will be shown in the subsequent analysis

In Figure 2 we have represented in a similar manner the references to articles which originated outside of the United States. Here we see the falling off in 1915 is even more marked and continues in 1916–17 (instead of rising again as in the previous figure), finally reaching a minimum in 1918 It will be argued by some that research was carried on but was not published during this period because of prohibitive costs and general unsettled conditions in Europe There are two answers to this objection. In the first place, it has already been pointed out that unpublished research is not completed research, because dissemination of knowledge is essential to scientific progress. Secondly, the trend-curve actually shows that some of this research was published in 1919 and 1920 after hostilities had ceased. If we consider what would be normal recovery from the minimum reached in 1918 we must conclude that the trend-curve should increase in slope with time, it should be concave upward. The dotted line in the figure indicates such a normal recovery curve The actual curve is, however, decidedly convex. In other words, if we were to choose 1921 as a temporary standard, the number of references to articles published in 1920 and 1919 is too large. The cross-hatched section of these columns is meant to represent the excess over normal recovery This then is thought to represent research completed during the war but not published until later. This effect will also be found to an equally marked extent in the curves which follow

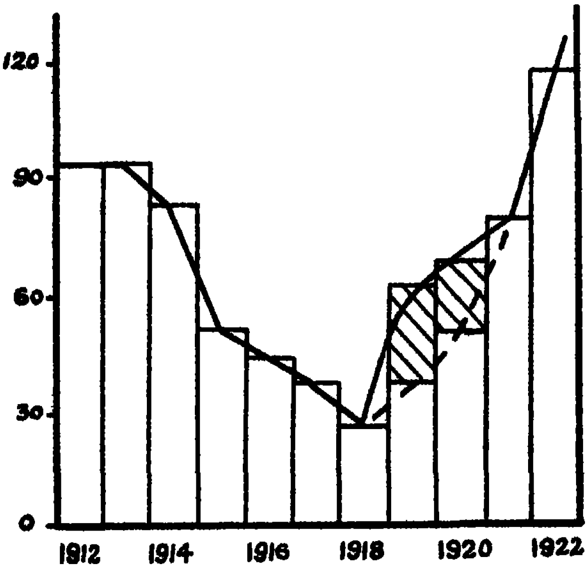


FIG 2

It is obvious from consideration of Figure 2 that the course of research in the United States from 1914 to 1919 was different from its course in the rest of the world We might investigate this still further by studying separately the trend in Germany, England and the United States This can be done by considering the references to four or five typical journals in each of these countries

In Table II we find the results of a tabulation of the references to five representative German journals. They were chosen to represent the fields of general, organic, inorganic, physical and biological chemistry References to *Berichte der deutschen chemischen Gesellschaft* far outnumbered those to any other single periodical in 1926. There was a total of 686 references to this journal. In other words, over 18 per cent of all references, excluding those to the *Journal of the American Chemical Society*, were to this single periodical. It is the more remarkable, therefore, that there was in 1926 not a single occasion for the investigators in America to refer to work published in the *Berichte* in 1918 It might be said that this is because the *Berichte* for 1918 was not available to American workers, but it should be remembered that although this might have been the case in 1919–20–21, it was not true after that By 1923 the files of the *Berichte* in American scientific libraries had been brought up

TABLE II

Year	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Ber.	16	18	10	12	6	5	0	8	11	12	19	21
Ann.	11	3	13	2	3	1	1	1	2	3	2	5
Z phys. Chem	4	9	5	1	4	0	0	0	2	5	11	11
Z anorg. Chem	1	1	1	1	2	0	2	4	3	6	4	2
Biochem Z.	2	2	4	1	0	2	0	0	0	1	2	4
German	34	33	34	17	15	8	3	13	18	27	38	43

Ber. *Berichte der deutschen chemischen Gesellschaft*, *Z phys. Chem.* *Zeitschrift für physikalische Chemie*,
Ann. *Annalen der Chemie* (Liebig's), *Z. anorg. Chem.* *Zeitschrift für anorganische Chemie*,
Biochem. Z *Biochemische Zeitschrift.*

to date, and therefore this journal was as available as any other when the work we are considering was being carried out.

The results of Table II are graphically portrayed in Figure 3. Here again the effect of the war is very

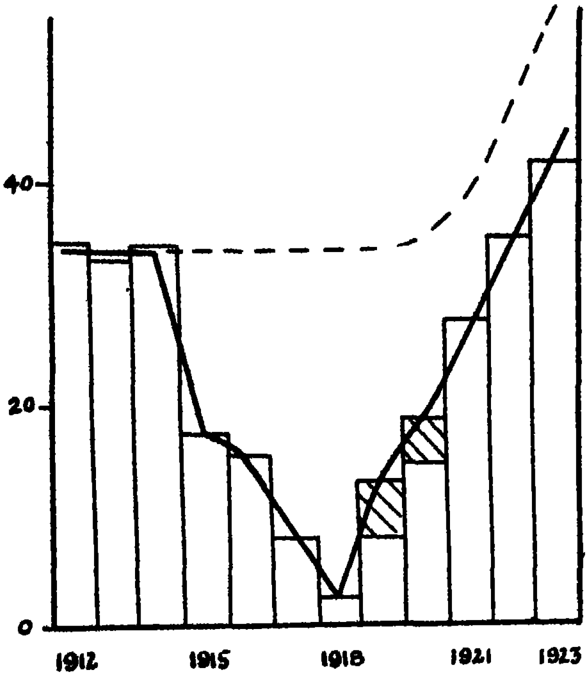


FIG. 3. References to five typical German periodicals

marked and we must conclude that research in this most fundamental science was at a very low ebb in Germany in 1918, that Germany was hard pressed The typical recovery curve noted in Figure 2 is also present here Undoubtedly the areas cross-hatched in 1919 and 1920 represent work completed during the war but unpublished until later Another point should be noticed here It is that, apparently, recovery in Germany was not complete even in 1923, because, as we have mentioned earlier, we would expect much higher figures for 1922 and 1923 than for 1912 and 1913, because of the nearness of the former to 1926 researches. The broken line in the figure might well represent the normal curve excluding the effect of the war The area between the broken line and the solid trend-curve is then a representation of the loss to fundamental science in Germany due to the war's effect

Turning our attention next to British research we find the results shown in Table III

It will be seen in Figure 4 that the effect of the war

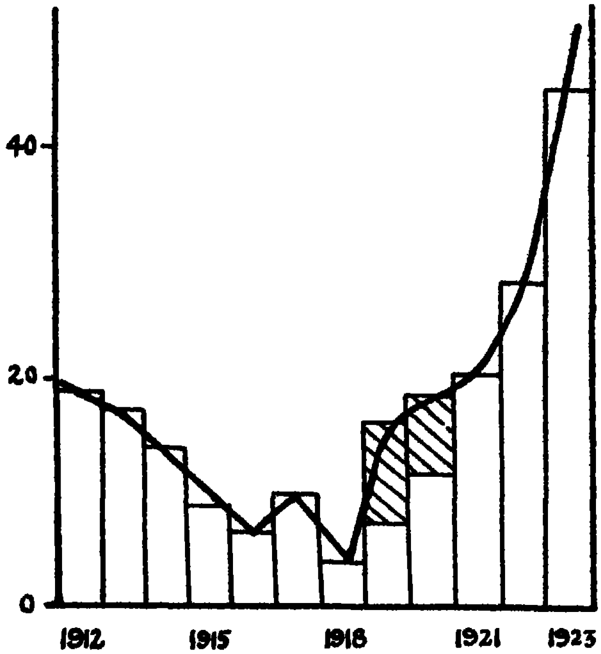


FIG. 4 References to four typical British periodicals.

on British chemistry was very similar to the effect noted in Germany, except perhaps that it was not so marked. The British loss was not so great because they did not have so much to lose The typical convex recovery curve in the cross-hatched area should be noted

The ultimate test of this method of measuring the war's effect on fundamental science should come when one considers a typical group of periodicals published in the United States. In 1914, there were in America basic industries, long dependent on Germany for certain essential chemicals; these industries found

TABLE III

Year	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
J. Chem. Soc.	15	13	14	8	5	5	4	10	12	13	17	28
Proc. Roy. Soc.	2	2	0	0	2	1	0	1	1	2	3	7
Phil. Mag.	2	2	0	0	0	4	0	5	5	4	2	2
Trans. Far. Soc.	0	0	0	1	0	0	0	0	0	1	6	8
British	19	17	14	9	7	10	4	16	18	20	28	45

J. Chem. Soc. *Journal of the Chemical Society* (London),
Proc. Roy. Soc. *Proceedings of the Royal Society*,
Phil. Mag. *Philosophical Magazine*,
Trans. Far. Soc. *Transactions of the Faraday Society*.

TABLE IV

Year	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
J Am Chem Soc	12	20	31	31	43	43	34	35	61	84	80	157
J Phys Chem	4	1	1	2	1	5	3	1	3	2	2	4
J Biol Chem	0	1	4	6	2	2	3	2	7	5	4	13
J Ind Eng Chem	0	0	3	0	3	1	1	3	2	4	1	11
Phys Rev.	0	1	0	0	2	3	0	0	3	2	1	2
American	16	23	39	39	51	54	41	41	76	97	88	187

J. Am Chem Soc *Journal of the American Chemical Society,*
J Phys. Chem. *Journal of Physical Chemistry,*
J Biol Chem *Journal of Biological Chemistry,*
J Ind Eng Chem *Journal of Industrial and Engineering Chemistry,*
Phys Rev *Physical Review*

themselves suddenly cut off from this source of supply If we call to mind the need of the textile industry for dyestuffs, the seriousness of such a situation is at once apparent It is to be expected, therefore, that the war should give scientific research in this country a decided impetus There should be no marked falling off in 1915 In fact, we should not expect any decrease until after our entry into the war or even until 1918 Let us consider the facts uncovered by this method of investigation

In Figure 5 the results of Table IV are graphically

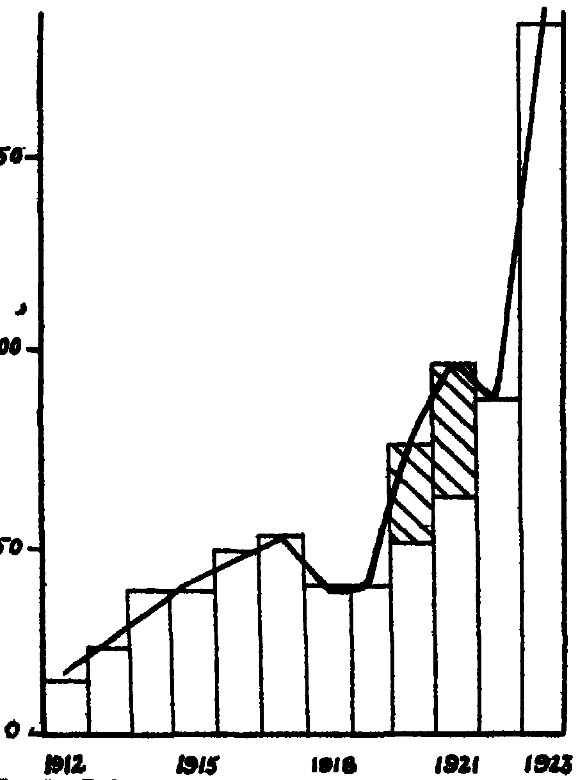


FIG. 5. References to five typical American periodicals.

shown It will be seen at once that our predictions are correct The trend-curve instead of dropping off as in the previous cases in 1915 continues to rise until 1917 A slight decrease is found in 1918 and 1919 It will be noted further that there is a difference in the location of the cross-hatched area in this figure Instead of being in the usual place (1919–20) it is shifted a year to the right (1920–1921) This shift may be explained as due to two causes The first is that in America, especially in the case of the *Journal of the American Chemical Society,* publication is much slower after submission of the manuscript because of the delay occasioned by sending the manuscript to three or more referees for judgment before publication This often delays publication for fully six months. The second reason, not an unimportant one, is found in the fact that in America immediately after the war there was an unprecedented rush of the demobilized men to the graduate schools of science. This undoubtedly increased the ordinary curricular and academic duties of the research man in the universities and caused a further delay in the preparation of manuscripts, the work for which was completed during the war In still other cases, the necessary permission of the War Department had to be obtained before work of this kind could be published. The maximum in 1921 may also be due in part to the work of graduate students who took part in this general return to schools immediately after the cessation of hostilities.

In conclusion we may summarize our findings as follows

(1) War acts as a serious deterrent on research in combatant countries.

(2) War may give a distinct impetus to science in certain instances, especially in the case of research in countries which maintain neutrality This is also magnified by the needs of a country (such as the United States in the last war) when it is suddenly cut off from supplies needed for basic industries, *e.g.,* dyestuffs for textiles, etc.

(3) Research in chemistry in Germany suffered far more than it did in England.

(4) The war, on the whole, had a distinctly beneficial effect on research in the fundamental science of chemistry in the United States

P. L. K. Gross

Department of Chemistry,
Pomona College

SCIENTIFIC EVENTS

AWARD OF THE CONWAY EVANS PRIZE TO SIR CHARLES SHERRINGTON

In February, 1925, the residuary trust funds of the estate of the late Dr Conway Evans, medical officer for the Strand district, who died in 1892, were transferred to the president of the Royal Society and the president of the Royal College of Physicians of London and their successors in office that, in accordance with the terms of his bequest, they

> shall apply the same in giving rewards to such person or persons who, in the opinion of the presidents, have rendered or shall from time to time render some valuable contribution or addition to science as it exists at the time of my death either by invention, discovery or otherwise

In accordance with this trust, the president of the Royal Society and the president of the Royal College of Physicians of London have made the first award of the Conway Evans prize, amounting to five hundred guineas, to Sir Charles Sherrington, on the ground that his work on the physiology of the nervous system, and chiefly on the physiology of the brain and spinal cord of the higher animals, has brought many complex nervous functions for the first time within the range of investigation and analysis His discoveries have had a profound influence throughout the world on the experimental sciences of physiology and psychology and have thrown a flood of new light on many of the symptoms of nervous disease In making his first award for some valuable contribution to science as it existed at the time of the death of the testator, the presidents of the Royal Society and of the Royal College of Physicians state that they have had no hesitation in selecting as conspicuously worthy of such recognition the work of Sir Charles Sherrington, which they believe to be of outstanding value for science and for humanity.

EXPLORATIONS IN THE REGION OF LAKES TITICACA AND POOPO

An important journey in the region of Lakes Titicaca and Poopo, according to the *Geographical Journal*, was undertaken last year, with the support of various German bodies, by Dr. K. Troll, of Munich, who describes some of his results in *Petermanns Mitteilungen*, 1927, Nos. 1–2 and 7–8. The program laid down was very extensive, and included a study of the geology and morphology of the Bolivian Altiplano and its surrounding ranges, as well as of the vegetation and the agriculture, actual and potential The La Paz valley was first examined and its relation to the glacial epoch made out A careful study of the shores of Lake Titicaca and its ancient terraces was next made, and it was ascertained that the highest level (representing the Lake Ballivian of Bowman) was considerably older than the last ice-age The next piece of work was the examination of the Cordillera and its eastern escarpment between Illampu and Apolobamba, where little had been known of the direction taken by the crest of the range and its relation to the hydrography The conditions were found very similar to those of the La Paz system, the range being several times broken through by the Rio Mapiri, so that here too the water-parting is merely the sharply cut edge of the Altiplano As in the case of the La Paz, the trenching was pre-glacial Dr Troll was able to join Professor A Possnansky in a descent of the Desaguadero from Titicaca to Poopo in a motor boat, this being the first occasion on which the whole course of the river had been navigated It led to the discovery that the river has since 1922 shifted its course considerably to the east before entering the lower lake While traversing the Pampa north of Poopo (which is dry and not swamp as shown in the 1-M map of the American Geographical Society) the river flows at a slightly higher level than the surrounding plain, and its bank seems to have been breached at high water Much attention was paid to the history of the lake basins in recent geological times, and some of the conclusions of Bowman as to the relations of the two ancient lakes ("Ballivian" and "Minchin") are considered to be incorrect Both the modern lakes have shown a decided rise in level of late years This had been known for some time as regards Titicaca, but Dr Troll was able to establish the fact for Poopo also, where much vegetation on the banks has been killed by the flooding It seems that the cause is a climatic one Even though the journey was made at the end of the dry season, Poopo was found to be discharging by the Lacahuira River towards the "Salar" of Coipasa, although the lake has been held (as by Neveu-Lemaire of the French Commission of 1903) to have no outlet. (May not the discharge be a recent phenomenon, due to the rise in the level of the lake?) Dr Troll ends by speaking of small remnants of primitive inhabitants that are still to be met with on the Altiplano, distinct from the Aimara and Quechua, and discusses recent projects for using the Desaguadero for navigation and irrigation. At the time of writing he was continuing his researches.

THE STOLL-McCRACKEN SIBERIAN-ARCTIC EXPEDITION

AN expedition, to be known as the Stoll-McCracken Siberian-Arctic Expedition of the American Museum of Natural History, is preparing to explore new lands on the Arctic coast of Siberia and collect flora and fauna for the museum.

The expedition will be financed and directed by Charles H Stoll, a New York lawyer and sportsman, and led by Harold McCracken, associate editor of *Field and Stream*, who has spent five years in the Arctic and who is known as a photographer of wild animals He spent two years at the head of an Ohio State University expedition in Alaska Captain Robert A. Bartlett, commander of the *Roosevelt* when Admiral Peary reached the North Pole, will command the expedition's vessel, the *Morrissey*, which was used during the past two years by George Palmer Putnam on expeditions to Greenland and Baffin Land

Other members of the expedition include Dr H E Anthony, curator of mammals of the American Museum of Natural History, R B Potter, of the museum staff, and Edward Namley, of Marietta, Ohio, operator of the *Morrissey* radio.

The search for the natural mummies of the post-glacial period will be one of the objectives of the expedition. The party will explore Czar Nicholas II Land, an island of unknown size north of Cape Chelyuska off the coast of Asiatic Siberia, about 600 miles south of the Pole. It will study the economic possibilities of Kamchatka, which is rich in timber, coal, gold, lead, zinc and other minerals, and in grazing lands. But it will be concerned chiefly in hunting for the museum specimens of animals and birds of the north.

The expedition will sail north from Seattle about April 1 Captain Bartlett left on December 8 for Sydney, N S, to bring the *Morrissey* to New York to be outfitted for the journey. He will then sail through the Panama Canal to Seattle to await the party.

The exploration will last about six or seven months. The *Morrissey* will sail from Seattle by the inside passage to Kodiak, Alaska, and thence to Unimak Island on the western end of the Alaska peninsula. The next stop will be Kamchatka, whence the journey will be up the Siberian coast and, when the weather permits, through the Behring Straits to the Arctic coast near the mouth of the Kolima River, where collections will be made

THE NEW ALLEGHENY FOREST EXPERIMENT STATION

THE choice of Philadelphia as headquarters for the Allegheny Forest Experiment Station of the forest service, United States Department of Agriculture, has been announced by Secretary of Agriculture William M. Jardine. The headquarters of the station are being established in cooperation with the University of Pennsylvania, and offices will be furnished by the university, under an agreement signed by Provost J H. Penniman, of the university, and Colonel W. B Greeley, chief of the U. S Forest Service Secretary Jardine made the following statement.

Selection of headquarters for the Allegheny Station marks the beginning of active work on the part of a new forest research unit of the Department of Agriculture. Although Philadelphia has been chosen as headquarters because of its central location and the stimulus to our work resulting from cooperation with a scientific institution of international repute, the field work of the station will be conducted at various centers in the States of Pennsylvania, Maryland, New Jersey and Delaware. In establishing such centers of field work, or branch stations, we have the advantage of cordial offers of cooperation from a number of organizations and educational institutions, prominent among them being the state agricultural colleges

The forest experiment station will be interested in nearly every phase of timber-growing, such as thinning and similar measures for stimulating growth, reforestation by natural methods as well as by planting, rate of growth of tree species, and protection of the forest against its many enemies The station is fortunate in starting its work in a territory where the states have done exceptionally good work in forestry The forest services of Pennsylvania, New Jersey and Maryland have been at work for years, and although the greater part of their effort has necessarily been devoted to fire protection, the management of state forests, and similar matters outside of the field of forest research, they have made substantial progress in this field as well.

Some idea of the extent of the forest problems in this territory may be gained from a comparison of the lumber production and consumption of the four states concerned. A combined production of about 400,000,000 board feet is scarcely one eighth of the combined consumption. Yet there are in these four states over 18,000,000 acres of forest land which once bore as fine a forest of hardwoods, white pine, and hemlock as grew anywhere in the United States The original forest has been practically all cut to meet the demands for wood of manufacturing, mining and agricultural industries. Forest replacement on hundreds of thousands of acres has been very inadequate, because of close cutting and fires. The scrub oak lands of Pennsylvania, and the ragged pine stands of southern New Jersey, to mention two outstanding examples only, are a challenge to the skill of the forester. Only painstaking study can give us the basis for the rehabilitation of such forests.

The staff of the experiment station will consist of seven persons at the start. Those appointed to date consist of R. D. Forbes, director, formerly director of the Southern Forest Experiment Station at New Or-

leans; O. M. Wood, of Pittsburgh, Pennsylvania; A. F. Hough, of Washington, D. C.; L. G. Schnur, of Erie, Pennsylvania, and Miss C. E Skamser, of Colorado Springs, Colorado.

THE LONG ISLAND BIOLOGICAL ASSOCIATION

At the annual meeting of the board of directors of the Long Island Biological Association, held on December 13, the following gifts were reported, applicable to the Biological Laboratory at Cold Spring Harbor, Long Island. About $15,000 have been received in contributions for research and current expenses during the year In addition the treasurer announced a bequest of $5,000 from the late Dr Walter B James Other special gifts, above the amount raised for current work, include $1,000 from Colonel T S Williams, $250 from Colonel Henry L Stimson, $200 from Dr. C B Davenport, and $200 from Mr Russell C Leffingwell, all for the recently constructed physiological laboratory Mr Walter Jennings and Mr William J Matheson made special gifts of $750 each, and Mr Mortimer L Schiff, of $400 for equipment for mammalian research The Wawepex Society contributed $500 additional toward the renovation of Hooper Hall Mr Arthur W Page donated subscriptions to scientific journals, and the estate of Mary E Jones gave the use of a building. The association has a number of building lots available for sale to biologists working at the laboratory A form of sale, similar to the forms in use at other institutions, was accepted by the board. The treasurer reported that the end of the fiscal year found the association free from loans or other financial encumbrances. A budget of $44,870 was voted for 1928.

Announcement was made of a gift of $12,000 from Mr. and Mrs. Acosta Nichols, of Oyster Bay. This gift is applicable toward the construction of a new laboratory for biological research It will be known as the George Lane Nichols memorial, in memory of George Lane Nichols who was for two years a member of the nature study classes for children given under the auspices of the Biological Laboratory The new research laboratory will be located near the recently finished physiological laboratory. The architecture will be that of the Long Island colonial type, including a main building about 50 by 25 feet, two stories high, and two ells each about 15 by 20 feet. Each room will be equipped with running fresh water and sea-water, gas and electricity, while all of the rooms on the first floor will have work tables capping solid concrete columns for use in research in which vibration and jar should be reduced to a minimum.

With the completion of this building late in the spring, the floor space available for biological work at the laboratory will have been more than doubled in three years This increase has been made necessary by the growing realization on the part of experimental biologists of the ease with which material for research may be procured at Cold Spring Harbor. This is particularly true of *Fundulus* and other marine forms The addition of another operating room and another animal room in the new building will also allow an increase in mammalian research.

At the same time living accommodations are being increased through the renovation of a large house purchased last year, and the purchase, upon very favorable terms, of another house from Mrs Alethea Stewart, widow of Mr. John H J. Stewart, a member of the board of directors for many years.

SCIENTIFIC NOTES AND NEWS

The American Association for the Advancement of Science meets this week in Nashville, under the presidency of Professor Arthur A Noyes, of the California Institute of Technology. Preliminary announcement of the programs of the fifteen sections and the associated societies will be found in the issue of Science for December 2 Dr L. H. Bailey, retiring president of the association, is recovering from a surgical operation and is unable to be present at the Nashville meeting He has not found it possible to prepare an address

Dr Samuel Wilson Parr, professor emeritus of industrial chemistry in the University of Illinois, has been elected president of the American Chemical Society for 1928, succeeding Dr George D Rosengarten, of Philadelphia.

Rudolph F Schuchardt, electrical engineer at the Commonwealth Edison Company, Chicago, has been nominated for president of the American Institute of Electrical Engineers for the term beginning August 1, 1928

The Langley medal for aerodromics was presented to Colonel Charles Lindbergh at the annual meeting of the board of regents of the Smithsonian Institution on December 8. At the same time Colonel Lindbergh announced that the backers of the *Spirit of St Louis* had met recently in St. Louis and had decided that the plane should ultimately be given to the Smithsonian Institution.

Dr. William J. Mayo, Rochester, Minnesota, was made commander of the Royal Order of the North Star by King Gustav of Sweden on November 28.

Professors Niels Bohr and Albert Einstein have been elected foreign honorary fellows of the Royal Society of Edinburgh.

The degree of doctor *honoris causa* of the University of Paris has been conferred on Sir Frederic Kenyon, director of the British Museum, and Professor J S E Townsend, Wykeham professor of physics in the University of Oxford

The honorary degree of D Sc was conferred by the University of Oxford on Edward Ball Knobel, for ten years secretary and twice president of the Royal Astronomical Society.

The Buckston Browne prize, which includes a medal and £100, of the Harveian Society of London for the best essay on "The Pathology, Diagnosis and Treatment of New Growths originating in the Walls of the Urinary Bladder," has been awarded to Lionel R Fifield

The Langley memorial prize, which was founded by a friend of the late Dr W. H Langley, principal medical officer of Southern Nigeria, has been awarded to Dr A S Burgess, of Accra, Gold Coast, West Africa, for his paper, "The Selection of a Strain of *Bacillus pestis* for the Preparation of Vaccine, with Special Reference to the Effect of Animal Passage on Virulence."

At the annual general meeting of the fellows of the National Institute of Agricultural Botany at Cambridge, England, Sir Daniel Hall, chairman of the council, presented the John Snell memorial medal for 1926 to Sir Matthew Wallace

The following officers of the Cambridge Philosophical Society have been elected for the session 1927–28 *President*, Dr H Lamb, *vice-presidents*, Professor J T Wilson, Professor A Hutchinson, Professor G I Taylor, *treasurer*, F A Potts, *secretaries*, F. P. White, R H Fowler and F. T. Brooks.

Professor Gosset, of Paris, has been elected president, and Professor Tixier, of Lyons, vice-president, of the French Congress of Surgery to be held during the coming year

The seventieth birthday of Professor S G Navaschine, the distinguished Russian botanist, was celebrated in Moscow on December 21 at a special meeting held in the university, when congratulatory addresses and greetings were presented to him

Nature notes that on December 7 Professor Louis Dollo, honorary conservator at the Royal Museum of Natural History at Brussels, attained the age of seventy years On that day there was presented to him a commemorative volume containing articles by fifty-five biologists, as an appreciation of his work in extending to fossils the laws that govern all forms of life

Dr R T A Innes is retiring at the end of this year from the post of director of the Union Observatory, Johannesburg.

Professor E C Williams has resigned from the Ramsay chair of chemical engineering, tenable at University College, London, to take effect at the end of the second term of the session 1927–28

Dr E H Farrington, for thirty-three years head of the dairy department at the University of Wisconsin, has been appointed emeritus professor of dairy husbandry

George A Olson, agricultural director of the Gypsum Industries, Chicago, has resigned, his resignation taking effect on February 1

Dean Gerald Wendt, of the school of chemistry and physics of the Pennsylvania State College, has resigned, effective July, 1928, to become director of the newly founded Battelle Memorial Institute for scientific and industrial research at Columbus, Ohio. Plans for the first two buildings of the new institute, costing about $500,000, are now being completed and construction will begin early in the spring.

Dr. John S Boyce, pathologist in charge of the Portland, Oregon, headquarters of the forest pathology work of the U S Bureau of Plant Industry, has been appointed director of the Northeastern Forest Experiment Station at Amherst, Mass. This appointment will be effective early in 1928, the station in the interim being in charge of M Westveld, associate silviculturist, as acting director

Harold A Thomas, professor of hydraulics in the department of civil engineering at the Carnegie Institute of Technology, has been appointed hydraulic engineer for the city of Pittsburgh to make a study of flood heights as affected by various proposed changes on the water fronts.

J N. Taylor, of Smyrna, Delaware, has been appointed to the chemical division of the Bureau of Foreign and Domestic Commerce, to be in charge of drugs and fine chemicals.

John A Stevenson, botanist in the office of foreign plant introduction of the U. S. Bureau of Plant Industry, has been transferred to the office of mycology and disease survey of the same bureau. He will have charge of the mycological collections, taking the place made vacant by the resignation of Dr. James R. Weir, who is now working on rubber-disease problems in British Malaya.

Dr. Ernest J. Wilhelm has been appointed to the newly established research fellowship in the depart-

ment of chemistry in the University of Notre Dame, for which funds have been provided by the Grasselli Chemical Co.

DR. JACOB MARKOWITZ, Toronto, has gone to the Mayo Foundation as first assistant in the division of experimental surgery and pathology

DR. HOWARD A KELLY, professor emeritus of gynecology, Johns Hopkins University School of Medicine, Baltimore, will deliver the Hunterian oration before the Hunterian Society in London, on January 16 The occasion is the two hundredth anniversary of the birth of John Hunter The last Hunterian address was delivered by Dr John M T Finney, of Baltimore

DR LOUIS B WILSON, director of the Mayo Foundation for Medical Education and Research, will be the founder's day speaker of the ninetieth session of the Medical College of Virginia, January 20 At the same time the cornerstone will be laid for Cabaniss Hall, the new women's dormitory

THE third annual Scripps Metabolic Clinic lecture for the San Diego County Medical Society will be given on January 7, at La Jolla, San Diego, by Dr Cyrus C Sturgis, director of the Thomas Henry Simpson Memorial Institute for Medical Research, Ann Arbor, on "Pernicious Anemia"

DR. SAMUEL L HOYT, of the research laboratory of the General Electric Company, will give the second of the annual Priestley lectures in chemistry at the Pennsylvania State College from January 16 to 20 Dr Hoyt will talk on "The Physical Chemistry of Metals and Alloys."

DR. OSKAR KLOTZ, professor of pathology and bacteriology, University of Toronto faculty of medicine, gave one of the DeLamar lectures in hygiene at the Johns Hopkins University School of Hygiene and Public Health on December 6 on "Yellow Fever in West Africa"

DR EDWARD STARR JUDD, of Rochester, Minn, recently gave the Mutter lecture of the College of Physicians of Philadelphia on "Gastric and Duodenal Ulcer"

THE Christmas week lectures for young people on the James Mapes Dodge Lecture Foundation of the Franklin Institute were given on December 27, 28 and 29 by Dr Wilder D Bancroft, professor of chemistry in Cornell University. The titles of Dr Wilder's lectures were "Combustion," "Comfort" and "Color"

WILLIAM BEEBE, of the New York Zoological Society, has returned from a lecture tour extending from St Paul to New Orleans on which he spoke over fifty times on the subject "Beneath Tropic Seas," dealing with his work on the life of coral reefs on his recent tenth expedition of the department of tropical research of the New York Zoological Society

PROFESSOR HAROLD D FISH, director of the Kartabo Laboratory of Tropical Biology, British Guiana, will lecture before the Geographic Society of Chicago on January 10 on "Jungle Explorations in British Guiana"

ON December 10, Professor Alan W C Menzies, professor of chemistry at Princeton University, delivered an address to the Royal Canadian Institute, Toronto, on the subject "Atoms and how they combine"

DR WM M DAVIS, professor emeritus of geology at Harvard University, will again visit the University of Arizona during the second semester this year as lecturer in physiography

ON December 3, Dr Chas N Gould, director of the Oklahoma Geological Survey, delivered a lecture before the Kansas Geological Society at Wichita, Kansas, on the subject "The Permian Problem in Kansas and Oklahoma"

THE Technical College in Vienna recently commemorated the centenary of the invention of the propeller, which is ascribed to Joseph Ressel, an Austrian forester

DR. R A HERMAN, lecturer in mathematics in the University of Cambridge, died on November 29, aged sixty-six years.

DR. M BAMBERGER, emeritus professor of inorganic chemistry at the Technische Hochschule in Vienna, died on October 22, aged sixty-six years.

PROFESSOR PAUL VON GROTH, for many years professor of mineralogy in the University of Munich, died on December 2, in his eighty-fifth year

ACCORDING to a cable to the New York *Times*, Professor Vladimir Michaelovich Bakhterev, the distinguished Russian psychologist, died on December 24, at the age of sixty-nine years

PROFESSOR DR. K. D. GLINKA, of Leningrad, Russia, who was elected president of the International Society of Soil Science during the world soil congress in Washington last June, died on November 2 He was known especially for his work in the field of soil classification.

PROFESSOR KEIZO NIWA, professor in the Tokyo Imperial University, an authority on Japanese pharmacology, died on October 19.

THE Philadelphia County Medical Society conducted a symposium on "The Oral Administration of Synthalin and Neosynthalin in the Treatment of Diabetes," at a special meeting on December 21. Dr.

E. Frank, professor of medicine at Breslau, Germany, discussed "Chemical Experimental and Clinical Investigation of Synthalin and Neosynthalin," and Drs. *Orlando H. Petty, Carl Schumann and Horace B.* Conway and W. S. Carr, "The Clinical Investigation of Synthalin and Neosynthalin"

THE spring meeting of the American Electrochemical Society, which will take place at Bridgeport, Conn., in April, will be featured by a symposium on "The Chemical Production of Electricity" under the chairmanship of Dr G W Vinal, of the U. S Bureau of Standards Among those who will take part in the symposium are Marion Eppley, president of Marion Eppley, Inc, Geo E Stringfellow, vice-president, Edison Storage Battery Co, M L. Martus, president, Waterbury Battery Co, and C A Gillingham, Works Mgr, National Carbon Co The discussion will include standard cells, dry cells, gas cells, storage batteries, electrolytic rectifiers, etc. This session will be held on April 26

THE Budapest correspondent of the *Journal* of the American Medical Association reports that on the suggestion of the secretary of the congress for cellular research held recently in Budapest, the management resolved to appoint one European committee and one extra-European committee Members of the European committee are Rhoda Erdmann, of Berlin, A. Fischer, of Dahlem, Germany, G Levi, of Turin, and Fauret-Premiet, of Paris The extra-European committee consists of R G. Harrison, of New Haven, A Carrel, of New York, and W. H Lewis, of Baltimore The cooperation of the two committees is maintained by Rhoda Erdmann, as the permanent general manager of the Society of Cytologists, whose periodical, the *Archiv fur experimentelle Zellforschung*, becomes the official organ of the society Within one year the delegates of the separate nations will organize those interested in cellular research in their own countries, and each of these national societies will delegate one member to the proper committee. Decision as to the time and place of the next congress must be made on the basis of the written votes of all the delegates. It was unanimously accepted that the name of the society be altered for a more general one in order to render possible the participation of members of other scientific societies The name of the society will be International Experimental Cellular Research Society.

THE shipment from China of scientific specimens obtained by archeological and other scientific research expeditions has recently been strictly limited as a result apparently of an increasing nationalistic spirit. Research has thereby been greatly hampered.

GIFTS by Edward Epstean, of New York, of 200 volumes to the chemical library at Columbia University and of the death mask, a cast of the hands, the photographic apparatus and two likenesses of the late Karl Klietsch, of Vienna, to the Chandler Chemical Museum, have been announced. Klietsch was the inventor of the photogravure and rotogravure processes, and his camera, plate-holders and his tools are of great interest

THE Hooper Foundation for Medical Research has set aside an annual allotment of $5,000 to carry on research in infantile paralysis Following an appeal to the public, the director of the foundation has received more than $7,000 in donations to be used in providing serum for children who may contract the disease

DR. R B WILD, who has recently retired from the Leech chair of materia medica and therapeutics at the University of Manchester, has made a gift of £250 for the endowment of a prize in pharmacology.

THE late Sir Arthur Shipley, of the University of Cambridge, bequeathed to the Molteno Institute his books connected with parasitology; to the Balfour Library his books connected with zoology, and to the Library of the Philosophical Society certain of his scientific books.

As has already been recorded in SCIENCE, Eldridge R Johnson, formerly president of the Victor Talking Machine Company, has given $800,000 to the University of Pennsylvania to establish the Eldridge R. Johnson Foundation for Research in Medical Physics. It will have as one of its purposes the scientific determination of the value which may attach to a variety of physical methods used in the study and especially the treatment of disease. Some idea of the range of studies that will be carried on in the new foundation may be gained from the fact that the plans call for six laboratories, each having a definite field of activity. They will be. (1) A laboratory for studies in light and optics, including investigations relating to sunlight, mercury-quartz lamp rays and infra-red rays Radium emanations, roentgen rays and highly related topics in this field also will fall under this division. (2) A laboratory for studies of the effects of heat, including the biologic aspects and the practical bearing of heat on problems of disease and its treatment. (3) A laboratory for studies in sound and audition, including the investigation of hearing and the application of instrumental methods for improving human hearing. This laboratory also will conduct studies in the reproduction of sounds (heart-sounds and the like), and in the physical effects of sound. (4) A laboratory for the determination of physical measurements—for studies of movements in

the human body such as heart action, movements of the stomach and intestines, the flow of blood and the intake and output of air. (5) A laboratory for photographic and cinematographic study of bodily processes and conditions. (6) A laboratory for the study of electricity in its relation to the diagnosis and treatment of disease.

DR. BARTON WARREN EVERMANN, director of the museum of the California Academy of Sciences, has, with the authority of the council, sent two men from the museum staff to the Galapagos Islands to do scientific work. The men sent are Mr Joseph R. Slevin, curator of herpetology, and Mr Frank Tose, chief of exhibits They sailed from San Francisco as the guests of Captain G Allan Hancock on his private yacht, the *Ococa*, on November 23 They planned to finally reach the Galapagos Islands about the first of December, where they expected to remain some time The purpose of the expedition so far as the academy is concerned is to do general collecting for the museum and to obtain accessory materials for a number of habitat groups, including at least one species of gigantic tortoise and one or two of the giant iguanas Captain Hancock is interested in scientific problems and especially in photography. He has taken with him as his official photographer Mr George E Stone, an expert in moving pictures and still photography. The expedition will return to San Francisco about the middle of January.

THE proposed standard on symbols for hydraulics has been prepared by subcommittee No. 2, of which G. E. Russell, professor of theoretical hydraulics of the Massachusetts Institute of Technology, is chairman. This subcommittee was organized on May 3, 1926, by direction of the executive committee of the sectional committee on scientific and engineering symbols and abbreviations of the American Society of Mechanical Engineers for the purpose of recommending a list of standard symbols for use in the field of hydraulics. The proposed tentative standard has received the approval of the subcommittee and is now being circulated with a request for criticism and comment Communications should be addressed to Preston S. Millar, secretary of the sectional committee.

Museum News states that a request for a city appropriation of $10,000 for 1928 has been made by the San Diego Society of Natural History, which bases its plea on the fact that its museum is open to the public daily, without charge, and that it maintains a school service, lecture program, nature walks and excursions and carries on explorations and research work. City funds are granted to three similar institutions in the city.

AN out-door botanical and biological laboratory and demonstration ground will be developed at the University of Wisconsin, if plans originated by Regent M. B. Olbrich, of the state university, and approved by the board of regents at its December meeting carry through The regents appropriated an $83,000 balance in the Tripp Estate fund to aid in the purchase of land adjoining Lake Wingra, with the understanding that at least as much more will be provided from other sources The Olbrich plan provides for the purchase of from 700 to 1,000 acres with a frontage of 8,000 feet on Lake Wingra—the whole of what is known as the Lake Forest area at Madison The tract would be set aside as a forest preserve, arboretum and wild life refuge.

GIFT to the State of Massachusetts of twenty-six acres in Boxford, to be used as an addition to the Crooked Pond Wild Life Sanctuary, has been announced by William A L Bazeley, state commissioner of conservation The givers are the Associated Committees for Wild Life Conservation, representing the Massachusetts Audubon Society, the Massachusetts Fish and Game Protective Association and the Federation of Bird Clubs of New England, Inc.

THE college of agriculture of the University of Wisconsin has been authorized by the university regents to engage in a cooperative program of forest conservation research with the state conservation commission and the U S Forest Service The problem which will first be studied under the authorization of the regents is treatment of farm wood lots and swamp tracts Problems relating to commercial forest tracts also are included in the general program

UNIVERSITY AND EDUCATIONAL NOTES

THE Yale University endowment fund drive has passed its goal of $20,000,000.

AT George Washington University the college of engineering, which was formerly under the department of arts and sciences, has been replaced by a separate school of engineering in the recent reorganization of the university.

DR. M. ALLEN STARR has given $2,500 to constitute the Starr Fund for the department of neurology in Columbia University, either the principal or income of which may be used at the discretion of the executive head of the department.

DR. GUSTAV BOHSTEDT, chief of the animal husbandry department of the Ohio Agricultural Experi-

ment Station, has been called to the University of Wisconsin to head the research investigations in animal husbandry, a position made vacant by the resignation of F B Morrison, assistant dean of the College of Agriculture, who recently accepted the directorship of the New York Agricultural Experiment Stations

At the University of California, E O Essig, associate professor of entomology and associate entomologist, has been appointed professor of entomology and entomologist at the experiment station Dr Edwin C Van Dyke, associate professor of entomology, has been appointed professor of entomology

Dr. Walter Bartke has been appointed assistant professor in mathematical astronomy at the University of Chicago

Dr. F R Davison, who for the past two years has been head of the bacteriology and biochemical departments of the Wm S Merrell Company, has resigned to accept the position of assistant professor in biochemistry at Rutgers University.

Dr Isadore D Bronfin, medical director of the national Jewish Hospital, Denver, has been appointed assistant professor of medicine at the University of Colorado School of Medicine, Denver

P C Raiment, demonstrator in biochemistry at the University of Oxford, has been appointed to the chair of physiology in the State University of Egypt, at Cairo

Dr. Stanislas Loria, professor of theoretical physics at the University of Lwów, Poland, has been appointed professor of experimental physics and director of the physical laboratory at the university Professor Loria spent two years, 1923 and 1925, in America working and lecturing as research associate at the California Institute of Technology.

DISCUSSION AND CORRESPONDENCE

WEIGHT AND TEMPERATURE

There is a recurrent myth to the effect that mass varies with temperature, hoary with age, familiar to most physicists and chemists It has been investigated many times and reported as due to convection currents of heated air acting either on the hot object weighed or on the balance pan

The apparent loss in weight of a heated object is perfectly definite and repeatable and is of the order of 50 milligrams for a platinum crucible or pyrex beaker having a surface of 100 square cm. when heated to 600 degrees The balance pan is protected from rapid heating by a ring or gauze of highly oxidized metal and the heated object left on it but a few seconds, just long enough to get the direction of the first swing. The temperature curve so obtained is a smooth hyperbola The effects of convection and of expansion of the balance arm are relatively sluggish in coming into play and are readily recognized and avoided by any one familiar with precise weighing

The apparent loss in weight is roughly proportional to surface and not to mass This was shown by comparing the effect on a thin platinum crucible with that on a platinum button The curves of loss in weight per unit area, plotted against temperature, were nearly coincident for glass, platinum and sheet gold but lower for aluminum, copper and iron (polished wire, coiled) The change with temperature is large at the lower temperatures, becoming less and less until at 900° it is too small to measure

Since hygroscopic materials change in weight on heating in the manner just described, the effect was at first attributed to loss of adsorbed water A lump of gold was weighed, then rolled into sheet, weighed, then melted into a lump, alternately, six times, each time heated to 600° to remove grease but weighed cold A film of moisture would cause the sheet to weigh more than the button A consistent difference of 1 2 mg was found, probably due to adsorbed moisture, whereas the loss of weight on heating was of the order of 40 mg Hence that loss could not be due to driving off adsorbed water

Next a platinum crucible and the sheet gold were suspended in a furnace and thus weighed at various temperatures The only change in weight found was a slight gain (2 mg.) such as would be caused by the decreased density and buoyancy of the heated air within the furnace. This disposed of the hypothesis of adsorbed moisture driven off by heat.

Finally, a crucial experiment indicated the actual cause of the apparent change in weight The effect was first carefully determined on a platinum crucible. Repeating with the crucible *inverted* showed precisely the same loss in weight Then a second crucible, slightly larger than that heated, was used as a cover for the heated inverted crucible, completely enclosing it down to the balance pan and eliminating convection currents entirely In this case also the loss in weight was the same as before The three losses check to within less than 2 per cent.

Warm air in contact with a heated surface must be at the same pressure as the surrounding atmosphere but less dense and more viscous. If it be lightly held in position (weakly adsorbed) by the solid, it will in effect increase the volume of the solid and therefore enhance the buoyancy of the surrounding air To produce the losses in weight observed, layers of fixed air 0.5 to 3 mm. deep would be required. This explanation is not entirely acceptable

but is apparently the only one in harmony with observed facts.

P. G Nutting

Geological Survey,
Washington, D C

INFLUENCE OF POLARIZED LIGHT ON PHOTOCHEMICAL REACTIONS

I have read with keen interest and great delight the article by Dr S S Bhatnagar appearing in Science for October 14, entitled the "Selective Effects of Polarized Radiations on certain Photochemical Reactions" In this article the author announced his findings concerning the remarkable acceleration of chemical reaction between the amalgams of the alkali metals and water produced by exposure to polarized radiations In the interest of historical accuracy and scientific priority I beg to submit for publication the following information which may not be known to scientists at large Our esteemed Hindu colleague states in his paper that "As far as the author knows, this is the first purely chemical reaction as distinguished from the biochemical reactions studied by previous investigators which has definitely been shown to be selectively affected by polarized radiations" It is evident that owing to the slow communication between the United States and India he was not aware of the fact that on April 12, 1927, I and Dr W. T Anderson, Jr, read a paper before the American Chemical Society at the Richmond meeting entitled "The Effect of Polarized Light on the Pharmacological Properties of Some Drugs" In that paper which was published in the *Journal* of the American Chemical Society for August 5, 1927, and which was broadcast by "Science News," we have described our findings concerning the effects of polarized light on the pharmacological and chemical reactions of certain drugs. The profound changes produced by polarized radiations on the substances studied were certainly due to photochemical changes produced in their chemical structure because the chemicals were first irradiated and only subsequently tested. This was demonstrated not only by pharmacological means but also in the case of cocain by purely physical chemical tests, namely, changes in hydrogen-ion concentration, and in the case of quinin tartrate by the changes produced in its optical rotation. It is hardly necessary to state that the drawing of distinctions between biochemical and other chemical reactions is mere academic quibbling I wish to call attention furthermore to the fact that a preliminary paper concerning the effects of polarized light on the reactions of certain drugs was published by me and John C. Krantz, Jr., in the *Journal* of the American Pharmaceutical Association for March, 1927.

In the present communication I wish to announce briefly the results of certain other experiments performed by me which I mentioned at the above meeting of the Chemical Society, but which were reserved for publication in a later paper I have studied the effects of polarized light on five groups of optically active alkaloids These were the following Cocain, Epinephrin, Hyoscyamin, Scopolamine (Hyoscin) and Physostygmin Solutions of each of these alkaloids after irradiation with polarized light were found to have undergone photochemical changes as evidenced by numerous pharmacological tests An examination of various stereo-isomers in this connection revealed the remarkable fact *that the laevo variety in every case was the one most profoundly affected by polarized light* These experiments have been in progress for a long time and would have been published at an earlier date had it not been for the unusually unsympathetic attitude towards our investigations on the part of certain American scientists, which fortunately did not discourage us in our work but which did compel us to repeat unnecessarily a large number of experiments otherwise quite clear cut, flawless and fool-proof It is but fair to add in this place that the whole investigation could not have been conveniently carried out had it not been for the encouragement and facilities extended to us by two private industrial laboratories, namely, the Pharmacological Research Laboratory, Hynson, Westcott and Dunning, of Baltimore, and the Physico-chemical Research Laboratory of the Hanovia Company, Newark.

David I Macht

Pharmacological Research Laboratory,
Hynson, Westcott and Dunning,
Baltimore, Maryland

FLOOD EROSION AT CAVENDISH, VERMONT

One of the tragic but geologically most interesting happenings connected with the recent Vermont flood occurred at Cavendish village, which is located on the east slope of the Green Mountains some fourteen miles from Summit Station on the Rutland Railroad

Here, during the early morning of November 4, after some twenty-four hours of heavy rain, part of a highway leading from the village down the valley was suddenly engulfed, carrying with it seven houses, numerous barns, garages and their contents Happily no lives were lost, but the unfortunate people, with almost no warning, witnessed the total destruction of their property and even of the land upon which it stood The loss is estimated at from $35,000 to $40,000

The draining away of the waters revealed, where once the road had been, a yawning gully some forty feet deep, two hundred feet wide at the bottom and

probably a quarter of a mile long The gully opened a new course to the river and, a mile below at the village of Whitesville, the remains of the structures were found, so utterly demolished as to be unrecognizable even to their former owners

Many places have been damaged in the past and some destroyed because a dam failed, here was one which suffered because the dam held.

The village of Cavendish is situated on the north margin of the flood-plain of the Black River, which rises in the mountains and flows in a generally southeasterly course to its confluence with the Connecticut The valley is perhaps half a mile wide at the village Just east a large hill rises dividing the valley into two branches The river flows through the south branch, where it has been dammed, while the highway in question ran through the north branch to Amsden, Ascutneyville and the Connecticut River. A dike in the valley, west of the hill, protected Cavendish from the impounded river water, while a storm-sewer laid under the highway drained the surface water down past the hill, where it could join the river. When the flood came the dam held fast but the dike broke and the sewer sections probably became loosened and carried away, thus enabling the flood waters to erode both above and below the highway with the disastrous results noted

The great gully, eroded down to an easterly-sloping, gneissic bedrock, reveals the pre-glacial channel of the river, showing striations, chatter marks and pool-basins at the foot of the old rapids. The retreat of the ice-sheet filled the valley with till and impounded a lake whose terraces are in evidence for several miles up the valley Later the river found a new outlet, this time to the south of the hill mentioned, and its old hidden course became a highway

And so, unwittingly, the villagers built their houses "upon the sand" and the floods have borne out the truth of the old parable as they probably have been doing ever since it was uttered.

E C Jacobs

University of Vermont

ILLUSTRATIONS WHICH DO NOT ILLUMINATE THE PROBLEM

In a recent issue of Science (November 4, 1927), Dr R G. Aitken, associate director of the Lick Observatory, contributes an article entitled "Old Problems with new Illustrations" in which certain statements of recent astronomical observations have been somewhat peremptorily challenged. The name of none of the offenders is mentioned, yet, in one case, the quotations used coincide verbatim with sentences in a recent article of mine, "Island Universes" (*Natural History*, Vol 26, 286, 1926, and Harvard College Observatory Reprint No. 32). Dr. Aitken furnishes additional identification marks showing that the quotations are from my article. In view of this I feel justified in trespassing upon the columns of Science in order to present the facts of the case.

Four points are specifically brought up by Dr. Aitken.

1 The total number of stars in the Galactic system is put down in my article as "about fifty billion," whereas Dr Aitken says that, "according to the most careful and reliable investigation so far made" this total number is very hesitatingly put at thirty billion. There is good evidence that the fraction of all the stars in space which are visible even with the greatest telescopes is probably in the neighborhood of one or two per cent. The estimated total therefore involves great extrapolation In describing the results in a popular article, where, as is evident, the argument requires an upper limit for this total number of stars, the use of fifty billion instead of thirty billion is not only justified by its practical equivalence, but it is almost necessary.

2 An objection is made against my statement that a star may be a thousand times as large as the sun in diameter. The facts are, as Dr Aitken says, that the largest measured diameter is certainly not more than half, and possibly not more than one third of this value.

In 1906 Hertzsprung published a formula for predicting the angular diameter of a star when the color and the apparent magnitude are known. When in 1920 the first stellar diameters were measured, they proved to agree within thirty per cent., which, I am sure, astronomers generally regard as an excellent agreement in the case of such pioneer work. We may then perhaps be allowed to consider the formula used by Hertzsprung as well established, and use it, to extend our values to other stars which had hitherto fallen outside the region of calculations. In Harvard Reprint 25 and Harvard Circular 271, 1925, Shapley cites the existence of some very red stars in the Magellanic Clouds which, on the basis of the formula predicting stellar diameters would have linear diameters of the order of magnitude of 10^9 kilometers, the sun's diameter being 1.4×10^6 kilometers. Here I should say that I can not satisfy the reader who looks for an exact statement to the nearest million miles; round numbers, which imply large uncertainties, are more to my liking.

3. I am accused of having remarked "blithely" that "fifty billion years is but a short interval in the life of an average star." I should indeed be most grateful to Dr. Aitken if he could produce any valid arguments to the contrary. Recent papers on stellar ages mention figures of the order of 10^{12} to 10^{13} years,

compared with which 5×10^{10} is indeed a short interval.

4. I wrote: "Observations with the spectroscope made *principally* at the Lowell and Mt. Wilson Observatories have shown us that the Andromeda Nebula is approaching us with a speed of 200 miles a second, the Magellanic Clouds are receding from us at the rate of 176 miles per second" It seems inconceivable that any one would be able to read into this sentence the meaning that "the Magellanic Clouds *have recently moved so far north* (italics mine) that their radial velocities can be and have been measured from Mt Wilson and Flagstaff" The radial velocities of these objects were actually observed at the Chilean station of the Lick Observatory, which might well have been mentioned

Summing up, I should say that I entirely agree with Dr. Aitken that the writer of a popular article owes it to his readers not to make overbold statements However, one must consider that in writing a popular article, one can not stop to explain all side issues, by footnote or reference, in the same way as is done in scientific articles, such points are essentially matters of personal judgment

WILLEM J. LUYTEN

HARVARD COLLEGE OBSERVATORY

ORIGIN OF THE PRAIRIE

PROFESSOR PHILIP M JONES in SCIENCE for October 7 (Vol LXVI, No. 1710) suggests as a theory for the origin of prairies in the Middle West "rapid drainage at the close of the ice age"

It is doubtful if this theory, or any other relying upon a single factor, can explain very extensive grassland areas, either in the Middle West or elsewhere

Treeless areas tend to develop in arid or semiarid regions, or where, even though there may be abundant rainfall, the water table is low by reason of unusually free subsurface drainage. In the latter instance, if indeed not in the former, the presence of a large number of grazing and browsing animals is an important factor. Starting on such "negative oases" these animals are apparently able to beat back the line of forest, even into regions where moisture conditions are not unfavorable to tree growth.

Such a region, apparently, one lying entirely outside of the glaciated district, was that which may be roughly defined as the portion of southern Kentucky and northern Tennessee lying between the Green and Cumberland Rivers. It also extended into southern Illinois. When first visited by white men it was treeless and covered with grass. The writer has seen in a collection of old maps in the Boston library one of this middle western country printed by John Sinex in Amsterdam, Holland (no date, but presumably in 1721) on which this region is designated as the place "where the Illinois hunt cows." This map is evidently a reproduction of an earlier one in which the legends were in French and where the word rendered "cows" in the later edition was undoubtedly "beufs" in the former. A proper rendition of the original inscription is therefore, "where the Illinois (Indians) hunt buffalo." The first description of this country brought back to English colonists of the Atlantic seaboard, was by a party of hunters, led by a German by the name of Casper Manaker, which setting out from North Carolina in 1769 (See Haywood's History of Tennessee) first broke out of the forest in what is now Wayne County, Kentucky, and there saw stretching toward the west a vast expanse of treeless upland, covered with grass, and grazing countless numbers of buffalo, deer and elk. Not yet having been introduced to the French word "prairie" as descriptive of such a region, these hunters called it "meadow land," and a creek at the headwaters of which by a spring they camped, "Meadow Creek" This creek, sinking a short distance below the spring, reappears again, only to plunge by steep descent into the gorge of the Cumberland River It still bears the name "Meadow Creek." So excellent was the hunting here, and so eager were the hunters to enrich themselves with skins and pelts that they forgot to return to their homes and families in North Carolina for two years For this when they did return they received the name "The Long Hunters"

When finally opened up for settlement this region was largely "passed up" by the early pioneers as "poor land," in accordance with the mistaken notion of persons acquainted only with the wooded country to the east that a soil that was not supporting trees must be poor indeed. Hence the name "Barrens," by which the region became known by the early part of eighteen hundred, when the Kentucky legislatures of that period wrestled much with the problem of inducing its settlement. One of the offers made to prospective settlers was the remission of taxes for a certain period of years. The early name for the region is still perpetuated in Big and Little Barren Rivers, and in Barren County, Kentucky, situated near the center of the area.

A geologic examination shows the Barrens to have been nearly coextensive with the outcrop of the cavernous limestone of the Mississippian series. It is a karst country abounding in sinks and caves and underground channels through which rain-water readily sinks and finds its way speedily into the major streams of the region. Hence it suffers much in times of drought. Hence also it would appear, that, aided possibly by forest fires, vast herds of buffalo and deer and elk were able to reclaim it from forest and

convert it into "the new land." It was here that the buffalo last lingered in Kentucky, a few of them having been seen here as late as 1818.

With the settlement of the country and the extermination of the large wild game, the trees, which still lingered along the major streams, and possibly, also, on the [illegible] of the sandstone knobs which are scattered over the region, began in their turn to reclaim the ground from which they had been driven, until now it [illegible] would be concluded that a person traversing the region who was unacquainted with its history would naturally [illegible] that each farm he sees is but the [illegible] of clearing won from virgin forest by the [illegible] of the sturdy pioneer, as elsewhere in Kentucky and Tennessee

ARTHUR M MILLER

ASHEVILLE, NORTH CAROLINA

SCIENTIFIC BOOKS

Bodenablagerungen und Entwicklungstypen der Seen By G Lundqvist Bd II of Thienemann's Die Binnengewasser, [illegible] 124 pp 14 pl. Published by E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart

FOR a number of years Swedish investigators have been studying the bottom deposits of lakes in southern Sweden [illegible] interesting and valuable information [illegible] obtained in these studies The present [illegible] primarily with these investigations The [illegible] treats of the methods of obtaining samples [illegible] descriptions and figures of the apparatus [illegible] the chemical and microscopical methods of [illegible] material, and with the system of representing results by diagrams

These [illegible] sediments are deposited in thin strata and the annual deposit of pollen makes it possible to [illegible] history of the beds, in this way it has been [illegible] that the period of time covered by them [illegible] few hundred years in some instances to a few thousand years in others

The relative proportions of the component materials serve to characterize the different types of sediments and a key for their identification is given, together with a series of thirteen microphotographs illustrating them.

The sediments are deposited in the form of beds and there is usually a succession of these beds whose sequence is dependent upon the solubility of the chief constituent of the deposit In some instances the deposits seem to be homogeneous throughout, but through [illegible] determinations and by microfossil analyses it can be [illegible] shown that they consist of a series of [illegible] Several types of bed sequences are shown by means of diagrams. In addition to chemical and biological factors, the character of the beds is affected by certain dynamic factors, such as wind, currents and exposure to wave-action. The final section deals with the regional distribution of lake types in southern Sweden A bibliography of sixty-nine titles is given.

Die Tierwelt der Unterirdischen Gewässer. By P. A. CHAPPUIS Bd III of Thienemann's Die Binnengewasser, 1927, 175 pp 70 figs

This volume deals with the animal population of subterranean waters, such as are found in springs and caves There are three chief sections which consist of (1) general, (2) faunistic, and (3) biological parts The general part treats of methods of collecting the fauna, the character of subterranean waters and the characteristic environmental conditions existing therein The subterranean fauna is divided into three ecological groups, namely, (a) Troglobionte, (b) troglophile, and (c) troglozene forms

The second part consists of a list of the fauna of subterranean waters together with notes regarding the various forms and their geographical distribution. Mollusca and crustacea furnish the largest variety of forms.

The third part, consisting of fifty pages, treats the morphological adaptations of this fauna and the influence of subterranean life on the various organisms, the effect on the eyes and other sense organs, on the color, size and breeding habits are discussed, together with the origin and age of this fauna and the effect of the glacial period upon it The bibliography includes 194 titles

C. JUDAY

MADISON, WISCONSIN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE SPIRALS WITHIN THE TERMITE GUT FOR CLASS USE

INSTRUCTORS in bacteriology often realize that it is not easy on many occasions to find a satisfactory source of spiral-shaped microorganisms for class use The proper varieties of bivalves are not always available and when one has a sufficient number of these at hand, one can not be certain that one will find satisfactory spiral material within them. Many also have made it a habit to look over students in an endeavor to find a marginal gingivitis since this condition yields most beautiful fields for direct smear or for the dark field. Young people, however, show this disease in rather limited numbers.

One of us (S. F. L.) while making a study of the

protozoan fauna of the termite gut[1] some years ago was impressed by the fact that the intestinal contents of these forms contain immense numbers of spiral organisms. It then occurred to us that these insects might offer a satisfactory source of supply of spirilla for class use in bacteriology. Repeated dissections according to technique which follows showed that material both for smear preparation and for dark field was rendered abundant immediately and with spectacular results The wide distribution of termites over the United States renders them readily available to laboratory instructors in many parts of the country and careful search will discover them in practically all regions.

The termites of the United States which are favorable for this use and which are common enough to furnish laboratory material over any considerable area belong to three genera *Termopsis* Hagen, the commonest west coast termite, *Kalotermes*, several species of which are found in the southwestern, southern and southeastern states, and *Reticulitermes*, with numerous species, which has an extensive range including the whole of the United States with the possible exception of certain of the northernmost central states In the Bay Region of California all three genera are present Of these genera, *Termopsis* and *Kalotermes* live entirely in wood, the former in decaying wood, the latter in sound, but dead wood, such as stumps or dead parts of living trees, in telephone poles and, further south, in house beams. *Reticulitermes* lives in the earth from which it attacks sound wood It is the cause of considerable economic loss due to its attacks on wood of buildings, etc

The genera have been named in the order of decreasing size and increasing difficulty of laboratory culture. The difficulties encountered in laboratory culture of the termites arise from the necessity of considerable humidity together with the susceptibility of the organisms to fungus attack. *Termopsis*, the largest of these termites, is also the hardiest. Living as it does in fungus infested wood it seems to have developed a resistance to fungus attack The simplest method of keeping laboratory cultures of *Termopsis* is by placing double cones of filter paper in finger bowls set in battery jars or museum jars The larger jar should contain half an inch of water and must be covered with a glass plate After some time on the filter-paper diet the wood particles disappear from the intestinal contents, which makes it easier to make smears. A more satisfactory arrangement for long periods or for the other genera is a series of mason jars with rubber stoppers pierced each with two glass tubes connecting by rubber tubes with the other jars, one of which contains water Here filter-paper cone may be used or, better still for long cultures, pieces of the wood taken with the colony

The whitish-headed individuals (nymphs of *Termopsis* and *Kalotermes*, workers of *Reticulitermes*) contain the most luxuriant flora. When material is needed the termite may be placed on a surface and held quiet by a probe pressed gently on the thorax. The extreme tip of the abdomen is then seized in fine-pointed forceps and by a gentle continuous pull the intestine may be removed. When teased the contents escape, including wood or paper fragments, great numbers of Protozoa, and the microorganisms. The lumen is lined with a close coat of spirals. Teased pieces of it mounted in Locke's or physiological saline present a beautiful picture The material thus obtained may be mixed with two or three drops of sterile physiological saline upon a microscope slide and from this smears may be made immediately Following air drying, they may be fixed by heat and then distributed to the students Ordinarily Ziehl-Nielsen carbol fuchsin diluted six to ten times with water gives a satisfactory stain The finest results, however, are to be obtained with the dark field condenser using the fresh gut contents diluted somewhat with sterile physiological saline

Beginning with Leidy the students of the Protozoa of the termite have noted the spiral organisms which abound in the gut. Leidy, in his first paper[2] spoke of the "spirillum" and later[3] named it *Vibrio termitis* Grassi and Sandias[4] speak of spirilla in European termites Dobell[5] describes *Spirochaeta termitis* from Ceylon termites, which he identifies with Leidy's species More recently they have been discussed both by Cleveland[6] and by Damon[7] Thus, we make no claim that these observations are original with us. We do desire to call the attention of laboratory workers and instructors to the fact that there is a source of spiral material which is easily available here in the United States.

T D BECKWITH
S F. LIGHT
UNIVERSITY OF CALIFORNIA

[1] Light, S F, *Univ. Calif. Publ. in Zool*, 1926, xxix, 150.

[2] Leidy, J, *Proc Acad Nat. Sci.*, Philadelphia, 1877, 141–149

[3] Leidy, J, *Jour Acad Nat Sci*, Philadelphia, 1881, viii (New Series), 425–447.

[4] Grassi, B, and Sandias, A, *Atti Accad Gioenia Sci. Nat Catania*, 1893, vi (series 4), Mem XII, and 1894, vii (series 4), Mem. I. English translation in *Quart Jour. Micr Sci*, xxxix, 245–315 and xl, 1–75.

[5] Dobell, C C, *Spolia Zeylanica*, 1910, vii, 65–86.

[6] Cleveland, L. R., *Quart Rev Biol.*, 1926, i, 51–60.

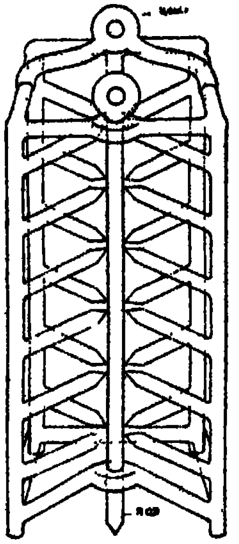
[7] Damon, S R., *Jour. Bact.*, 1926, xi, 31–36

A COVER-SLIP CARRIER

The apparatus described below has been used for some time by the author for carrying numerous cover-slips through the fixing, dehydrating and staining fluids. Its advantages are: (1) It carries many cover-slips at the same time. (2) It is easy to move from solution to solution. (3) It necessitates much less material in the end. (4) It gives a like treatment to every piece of tissue on the cover-slip.

It is a small glass cage with one side open for the slip to be inserted. This opening is closed by a glass rod. The shelves are made of glass prongs that do not quite reach the middle and are slightly tilted so as to drain to the main bars. A small handle surmounts the entire structure.

In moving from one solution to another the cage was rested on absorbent paper, thus allowing excess fluid to drain off. Small glass tumblers with ground glass tops were used for reagents.



Mr. Morgan, of Eimer and Amend, was extremely helpful in changing my design for a metal cage to a glass one and can give any necessary information.

Hugh H. Darby

New York University

SPECIAL ARTICLES

ON THE CHANGE FROM THE CONVECTIVE TO THE SPARK DISCHARGE OF THE MUCRONATE ELECTRODE

Apparatus. This is the same as described in my last paper,[1] E E' being the electrode discs (2 cm. in diam.) of the spark gap x of a small electrostatic machine. E' is provided with an axial tube leading to the interferometer U-gauge beyond U, for measuring the pressure of the electric wind from the needle point y protruding a little beyond E. S is the head of the micrometer screw by which y may be set in length until the pressure at U just vanishes and the convective discharge from E to E' (wind) breaks up into the pressureless spark discharge. If thereafter y increases but 1 mm., the pressure at U instantly becomes a maximum, and relatively enormous, as heretofore explained (see graph A). Hence the particular position of S in question may be called the critical set.

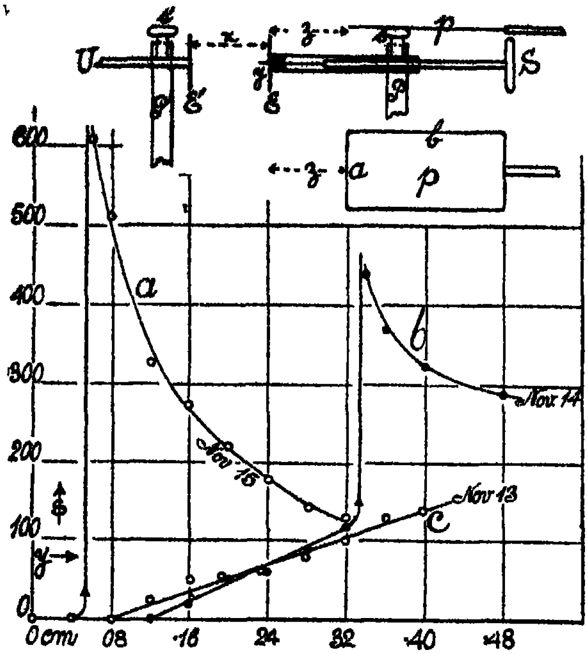
Observations. With the apparatus in this condition, I noticed (in the dark) that if the finger touched the set screw s of the post P, the strong electric wind E to E' immediately broke up into a hollow cylinder of sparks implying absence of all pressure at U. A faint brush was also usually seen at s' of the post P'. Removing the finger restored the wind and its pressure at U. At such times the cathode needle point, only, is faintly luminous. The experiment may, of course, be indefinitely repeated. On touching the anode at s' the behavior is similar, but much less marked. Sparking is apt to persist for the fraction of a second after withdrawing the finger, evidencing a kind of inertia.

It seemed probable that the cause of this occurrence would be the increased capacity of the electrode E and I therefore installed apparatus hoping to detect a relation between the extrusion y of the needle point, and the capacity increment in question. This I was unable to do consistently, as all capacities from 3×10^{-6} m.f. to about 10^{-3} m.f. often seemed to be equally effective in changing the wind into a spark succession. The larger capacities, however, admitted of a larger range of needle extrusion y. After long sparking the phenomena often seemed to tire.

As very small capacities were needed, I provided a set of rectangular proof planes p all about $b=6$ cm. long and of varying width a (see figure). These were made to touch the set screw s in succession.

The effect of this contact for $a=2$, 4, 5, 6 cm. was merely to produce momentary initial sparking, after which the wind pressure reappeared in spite of the presence of the plane. With $a=7$ cm., however, the plane in contact at s was able to hold the spark succession permanently, provided the s distance (see figure) exceeded about 5 cm. For small s, pressure again appeared. For $a=8$, 9 cm., etc., the plane became more and more dominating, and for $s=10$ cm.

[1] Science, XLV, 1927, p. 448



hold the spark even for $s < 5$ cm. and it sufficed to touch the prime conductor of the machine with the proof plane anywhere, however remote The finger contact was exceptionally effective, with the radiating glow at s' very marked These data give the general character of the experiment They will vary somewhat in different adjustments When the proof plane approaches s, a small spark jumps across to it, and it may be argued that this is probably what initiates electric oscillation between E and E', and thus breaks up the convection current from E to E' Moreover, a certain length s of the stem between E and P seems to be needed, supplying adequate self induction together with the capacity, to insure permanence of electric oscillation

In the presence of the proof plane, y must be increased to again initiate the convection current. To reproduce convection when the finger touches P, y had to be increased about .04 cm. After the removal of the plane, y must again be decreased to obviate convections, *i.e.*, the apparatus eventually oscillates under its own capacity. The behavior is in a way similar to the sensitive flame in acoustics, in which a smooth column begins to oscillate if stimulated Just why oscillation ceases when y is too long by almost infinitesimal amounts, I have not fully made out, but one is tempted to infer that the electric circuit in such a case is in a dead-beat, or a-periodic condition, with too much friction somewhere probably at and near the needle. From this viewpoint, to increase y is to increase the electric resistance of the circuit.

Incidental variations. The data which I have given refer to what may be called the normal (cathode) behavior of the machine and appurtenances. The pressure of the convection wind may then run up to over 600×10^{-6} atm At other times, which occur incidentally, the convection is always intermixed with more or less sparking and winds not much exceeding 100×10^{-6} atm in anodal pressure, may be the highest obtainable, while the critical extrusion (y) of the needle may be five times greater at the maximum pressure There may be no cusps in the graph This is a source of much confusion, for the clear cut evidence of one day may be negatived on the next. On such off days the effect of capacities, etc, is also varied. The spark succession is a brilliant line, not cylindrical, and there is often uncertainty as to the critical set of the needle electrode.

Three examples of y s graphs (s being the wind pressure in 10^{-6} atm) obtained on consecutive days, the machine (as such) working equally well in each case, are given in the diagram. One observes that the graphs are displaced bodily, high s and low critical y here going together

Later it was found (with double micrometer electrodes) that while the curve a is the true cathodal graph, curves b, c, are types of the corresponding anodal graphs and that passage from one to the other resulted from spontaneous changes of the polarity of the electrical machine Furthermore, when the critical set of the cathode is sharply made, the proof plane, if charged negatively, need not touch the cathode conductor, but is active (as by induction) from distances up to 10 cm. on either side of the spark gap x Pursuing this test, I then used the usual negatively charged hard rubber rod and found this capable of changing the quiet convection current into a spark succession from a distance of even half a meter in any plane or orientation above or below the spark gap and on either side of it A positively charged glass rod, on the contrary, had no observable effect anywhere. This puts a new face on the phenomenon, particularly as the increment of field impressed at the spark gap by the hard rubber rod is relatively small at best, and may actually be reversed, since the rod acts equally well on both sides of the spark gap. Finally, while the anodal behavior is in general similar, the positively or negatively charged rod has no effect on it in any position The emission of positive or of negative electrons is thus distinguished by an extrusion, y, 4 or 5 times larger in the former case.

CARL BARUS

BROWN UNIVERSITY,
PROVIDENCE, R. I.

COLD STORAGE VERSUS ROOM TEMPERATURES ON KEEPING QUALITIES OF FRUITS

It has become generally recognized that cold storage temperatures of 0° C tend to retard the ripening and thus prolong the period of edibility of most fruits as contrasted with room temperatures of 18° to 24° C (Powell,[1] Magness,[2] Overholser,[3] Carrick,[4] and others)

The fact, however, does not appear to be so widely recognized that the better the intrinsic keeping quality, at room temperatures, of the species of fruit stored the greater the *proportional relative* delay in senescence brought about by cold temperatures

Method of Procedure

Data obtained with a number of varieties of several species of fruits have been utilized to indicate the average keeping period as affected by storage at 0° and at 18° to 24° C The fruits were handled and observations made as previously described in other publications (Overholser, 1922, (with L. P. Latimer), 1924)

With the fruits stored, an optimum period and a maximum period was determined The *optimum storage period* referred to the average number of days the fruit could be stored and upon removal possess good quality and marketability The *maximum storage period* referred to the time beyond which it was unsafe to keep the fruit in storage, although it was still in fair to good condition, because of likelihood of loss of quality, softening of texture, susceptibility to rot organisms, tendency to wilting and rapidity of breakdown subsequently

Three pickings of the varieties of each kind of fruit were stored, the first being made soon after the beginning of the commercial harvest period, the second about the middle, and the third picking shortly before the close of the commercial harvest period for the variety.

Experimental Data

Data showing the relative effectiveness of 0° C and 18° to 24° C. in delaying the senescence of varieties of pears, plums, peaches and apricots, are presented in Table 1. The intrinsic keeping qualities of the species of fruits studied are generally considered by growers and shippers to be about in the order named, with the pears as a rule possessing the longest period, and the apricots the least period of marketability

[1] *U S D. A Bur Plt Indus Bul* 40 pp 9–26 1903

[2] *Jour Agr Research* 19. pp 473–500 1920.

[3] *Calif Agr. Exp Sta. Bul.* 344 pp. 426–463. 1922

[4] *Cornell Memoir* 81, pp 1–54. 1924.

TABLE I

The Relative Effectiveness of Temperatures of 0° and 18° to 24° C. in Delaying Senescence of Several Kinds of Fruit

Kind of Fruit	Number of varieties stored	Number of years observed	Temperature of storage Centigrade	Optimum storage period (days)	Maximum storage period (days)
Pears	52	6	0°	106	147
Pears	52	6	18° to 24°	12	16
Plums	21	3	0°	47	65
Plums	21	3	18° to 24°	7	9
Peaches	49	2	0°	37	50
Peaches	49	2	18° to 24°	6	8
Apricots	29	3	0°	23	32
Apricots	29	3	18° to 24°	5	6

Discussion

It should be pointed out that the actual number of days before senescence varied greatly, depending upon the variety, even within a species, and varied somewhat for a given variety depending upon the maturity when harvested, the region where grown, the season and other factors Of course, some varieties of a given kind would keep much longer and others much shorter periods of time than the averages given Nevertheless it is believed that the data indicated the average difference in keeping qualities of the several kinds of fruits.

It should also be pointed out that certain varieties within a given species kept relatively long at 18° to 24° C and comparatively short periods of time at 0° C Furthermore, with other varieties of the same species the reverse was true The deductions, therefore, apply only to the average response of the varieties of a given species as contrasted with the fruit of another species

Deductions

The pears, which had the longest period before the approach of senescence, kept about nine times longer at 0° C. than at 18° to 24° C. The plums, which possessed on the average the next longest period before senescence, kept about seven times longer at 0° C than at 18° to 24° C In a similar manner peaches kept six times and apricots only five times longer at 0° than at 18° to 24° C.

The data show that the effectiveness in retarding senescence of cold storage temperatures (0° C.) as contrasted with temperatures of 18° to 24° C. varied, depending upon the inherent keeping qualities of the species.

The longer the fruit could be retained at room temperatures the greater proportionally was senescence delayed by cold storage temperatures, and a comparatively few additional days in the keeping period at the higher temperatures indicated a rather marked additional keeping period at 0° C.

Fruit of a species which at room temperatures kept on the average only one or two times longer than fruit of another species tended to keep at cold storage temperatures as much as four or five times longer than that of the second species when both were subjected to the low temperatures

E. L. OVERHOLSER

NORTHERN BRANCH
COLLEGE OF AGRICULTURE,
DAVIS, CALIF

RELATION OF THE ADJUSTMENT OF SOIL REACTION TO BLACK ROOT-ROT OF TOBACCO

A SOIL made less acid by the use of lime is favorable to the development of black root-rot of tobacco, caused by the fungus *Thielavia basicola* Zopf Anderson, Osmun and Doran[1] found that black root-rot caused practically no loss in a soil more acid than pH 5 6 and that it caused severe loss in a soil less acid than pH 5 9 In soil having a reaction too nearly neutral, loss caused by black root-rot may continue to increase for at least four years after the application of lime. A quick method of increasing soil acidity is needed so that tobacco may be grown profitably on such soil The results of experiments in 1926 on the relation of acidifying chemicals to the hydrogen ion concentration of the soil and to the control of black root-rot are here summarized

Acids were applied to soil of known pH value infested with *Thielavia basicola,* and in such soil tobacco was grown. Results were measured in terms of effect on pH value of soil, growth of plants and infection of roots.

Equivalent quantities of nitric acid and of sulphuric acid had practically the same effect on the pH value of the soil, lowering it in proportion to the quantity of acid used. When soil was acidified by the addition of a little dry soil which had previously absorbed concentrated sulphuric acid or nitric acid, the pH value of the soil was lowered about as much as when equivalent amounts of these acids in water were applied directly to it.

All acids used lowered the pH value of soil when first applied. But it soon reverted toward or to the original pH value in the case of the organic acids used—citric, lactic, malic, tartaric and acetic.

Orthophosphoric acid had much less effect in lowering the pH value of soil than did equivalent amounts of nitric acid or sulphuric acid. When the only object was to increase soil acidity, nitric acid or sulphuric acid used alone was as efficient or more efficient than when either of these acids was applied together with orthophosphoric acid to the soil.

Field experiments were conducted in a soil of the Gloucester Series, with a pH value of 5.9, severely infested with *Thielavia basicola.* During the growing season, the pH value of this soil was lowered 0 10 by 200 lbs inoculated sulphur per acre, 0.15 to 0 20 by 400 lbs inoculated sulphur per acre, and 0 15 to 0 25 by a combination of 1,800 lbs. sulphuric acid and 400 lbs. orthophosphoric acid per acre. The quantity of acid necessary to apply to a soil to produce a definite increase in soil acidity depends on the buffering of the soil and can not be exactly predicted for any other type of soil than that on which it has been determined experimentally In this field the pH value of the soil was lowered enough by the acid treatments to be unfavorable to infection of roots by Thielavia The yield of tobacco in treated plots, as compared with yield in plots not treated, was increased 28 per cent by 200 lbs. sulphur, 34 per cent by 400 lbs sulphur and 58 per cent by 1,800 lbs sulphuric acid together with 440 lbs orthophosphoric acid per acre

In pot experiments, the increases in soil acidity resulting from the application of nitric acid and of sulphuric acid were equally efficient in preventing severe black root-rot. The only organic acid used which protected tobacco against infection was acetic. Plants were free from black root-rot or showed only a trace in soil infested with Thielavia to which acetic acid was applied Acetic acid has no lasting effect on soil reaction and its effect is probably to partially sterilize the soil

The application of orthophosphoric acid to soil infested with Thielavia resulted in root infection more severe than that on check plants Orthophosphoric acid is seemingly as favorable to infection by Thielavia as is lime In the presence of abundant orthophosphoric acid, black root-rot may be severe in relatively acid soils. The use of orthophosphoric acid together with sulphuric acid or with nitric acid usually resulted in more black root-rot than when sulphuric or nitric acid was used alone. But in spite of the severe root infection which it induced, orthophosphoric acid resulted in a great increase in the growth of plants.

The acids were all more toxic to tobacco plants in

[1] Anderson, P. J., A. Vincent Osmun, and W L. Doran, "Soil Reaction and Black Root-rot of Tobacco," *Mass. Agr. Expt. Sta. Bul.* 229, 1926.

poorly buffered than in well buffered soil. The acids most toxic to germinating seeds and seedlings of tobacco were citric, malic, tartaric and nitric acids. Acetic acid was the least toxic to plants of the organic acids. Nitric acid was much more toxic to plants than was sulphuric acid.

When soil reaction is adjusted by acids, the germination and growth of plants can not be correlated with pH value of soil except for each acid considered separately, the optimum pH value of soil for growth of the plant depends on what acid was used to adjust the soil reaction.

WILLIAM L. DORAN
MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

ENTEROMORPHA AND THE FOOD OF OYSTERS[1]

A NUMBER of investigators have suggested the probability that spores of algae may at times enter into the food supply of oysters, but the possible importance of this element under certain conditions seems not to have been realized The purpose of this note is to point out that this factor is at times of very great significance to the oyster and presumably to other plankton feeders, and to suggest one reason why its importance has been underestimated The observations upon which it is based were made in Barnegat Bay, New Jersey, during the summer of 1927, in connection with the oyster studies conducted by the Department of Biology of the New Jersey Agricultural Experiment Station.

Of the three species of Enteromorpha occurring in Barnegat Bay, *E plumosa, E. intestinalis* and *E. compressa*, the last named is commonest, growing everywhere on shells and stakes, and also attached directly to the mud of the shores of the salt marshes which line a large part of the Bay. In 1927, the spring vegetative growth of this species was largely completed by June 15, and zoospore discharge had commenced, continuing at frequent intervals until the end of July, by which time practically the entire substance of the fronds, excepting only the old cell walls, had been converted into nannoplankton. During this period zoospore discharge took place an hour or two after sunrise on every quiet, clear day, the zoospores swarming actively until toward noon, when they began to settle. Thus there were four or five hours on every such day when the water contained countless swarms of these organisms. The zoospores are pyriform, with four flagella and a single chromatophore, mostly from 5 to 7 μ long and from 4 to 6 μ broad, although there is some variation beyond these limits. It is not surprising that cells as small as this are not present in net collections, but it is surprising that so little evidence of their presence is seen in examination of the stomach contents of oysters living and feeding in immediate proximity of the fronds. In order to see whether the zoospores are ingested, an oyster was placed in an aquarium together with a mass of Enteromorpha just about to discharge zoospores. The shells of the oyster were open most of the morning and it was evidently feeding actively. Shortly after noon it was opened and the stomach was found to be packed with a bright green mass of food material, yet when examined under the microscope, the mass contained few recognizable zoospores, the great majority of the organisms visibly present being either diatoms or peridines. There were, however, numerous masses of greenish matter immersed in mucus to be seen, and careful study of these under an oil immersion objective showed unmistakably that they were composed almost entirely of the partially disintegrated zoospores, which were obviously being digested much more rapidly than the larger and better protected forms.

As a further test, several oysters were kept out of water until their stomachs were largely emptied of food. They were then opened, and drops of the nearly colorless stomach contents were placed on slides to which Enteromorpha zoospores and small diatoms from cultures were added. Similar drops were added to small quantities of the same organisms in vials. In all cases, visible disintegration of the zoospores began within fifteen minutes; they were largely destroyed at the end of an hour, and only a few traces of them were left at the end of two hours. During the same time, there was no perceptible alteration in the appearance of the diatoms. Evidently, by reason of their very thin cell walls and minute size, the zoospores are quickly digested, while the better protected diatoms and peridines, and even such forms as Euglena, resist digestion for a much longer period. The enormous numbers of such spores liberated and their remarkably rapid assimilation suggest that under the conditions existing in Barnegat Bay the zoospores of Enteromorpha form an important element in the food of plankton eaters during such times as they are being discharged. To these must be added the spores of species of Ulva, Monostroma, Ectocarpus and Pylaiella, certain of which are at least locally abundant in the Bay, and not only add to the total amount of such food present, but materially lengthen the period during which it is available.

G. W. MARTIN
THE STATE UNIVERSITY OF IOWA

[1] Publication No. 9, N. J. Oyster Investigation Laboratory.